The Corinth Canal, and Proposed Methods of Blasting and Removing the Material.*

WRITTEN FOR ENGINEERING NEWS BY GEO. J. SPECHT, C. E.

Before entering upon an account of the operations at this canal, I shall give a brief description of the canal itself.

The Isthmus of Corinth is bounded to the north and south by mountain ridges, which rise respectively to 900 m. (2,950 ft.) and to 600 m. (1,970 ft.) It forms a low plateau between these ridges, the highest point of which is a divide, running from northeast to southwest, and from 70 m., 80 m., (230 ft., 263ft.) above the sea-level. Only about half this plateau consists of a rocky mass, the other half is formed of alluvial deposits.

The owner of the franchise for this canal, General Türr, engaged Mr. Gerster, a civil engineer, who had taken part in the location of the Panama Canal, to study the country and make the necessary investigations and estimates. After examining three different lines, he finally adopted one, which very nearly is the same as that commenced by the Roman Emperor Nero. It cuts the isthmus at its narrowest place in a perfectly straight line, is 6,342 m. (20,800 ft.) long, with a highest ridge of 78 m. (256 ft.). General Türr in describing the traces of Nero's work, as found by him says: "On the side of the Gulf of Egina, an extensive depression of the ground can be observed, which is about 40 m. (131 ft.) wide in the bottom, and about 1,500 m. (4,920 ft.) long. The material excavated was deposited on both sides of this cut, as the swell in the ground clearly indicates. In the rocky ridge several steps or terraces have been cut, from which to start the excavation; they reach as high as 59 m. (139 ft.) above sea-level. But all these excavations are only a few inches deep. On the west side the work of the Romans can be traced 2,000 m. (6,560 ft.) from shore, but they cannot have been very deep. Along the line, there are a number of square shafts, 3 m., 16 m. (99 ft., 525 ft.) deep, the vertical walls of which are still perfectly intact. Besides these shafts there are two well preserved cisterns on the plateau, which can be used for the new work." Dr. Th. Friedrich gives the following historical data: "The cutting of a canal through the isthmus of Corinth, in order to avoid the long and dangerous voyage around the Peloponnesus, was attempted four times, but always without success. First, Demetrios Poliorketes (Strabo 54) tried it; but he was frightened off by the assertion of his mathematicians, that the sea on the west side was higher than on the east side, so that the Island of Egina would be overflowed.

Then it was attempted by Cæsar shortly before his death (Plutarch, Cæsar 58, also. Suet. Cæsar. 44) and then by the Emperor Caligula Suet. Calig. 21) and finally by Nero, who commenced and proceeded in earnest, until prevented by his death.

In a dialogue, called Nero, and written by Lucian, Menecrates describes to Musonius the opening ceremony of the work as follows: "Nero stepped forward from his tent and sang a hymn to Neptune and Amphitrite, and a short poem about Melicerte and Leucrothea. Then, after a golden spade had been handed to him, the protector of Greece went to the cut, and in the midst of great applause and singing from the assembled people, struck the ground three times; then he admonished those whom he had given charge of the work, to commence and continue the undertaking with zeal. After this he returned to Corinth, being convinced that he had surpassed all the great works of Hercules.

"The rock work was done by prisoners, while the lighter earth work was done by soldiers.

"But after we had spent one week and five days on the isthmus, the rumor reached us, that Nero had abandoned the project, as the Egyptians, having taken the level of the sea on both sides, had found that the one is higher than the other, and therefore the canal would endanger Egina. But the truth is, that even the greatest and wisest man, Thales, could not have dissuaded Nero from his attempt."

The movements of the western nations and the conqueror Vindex, distracted Nero's attention from Greece and the isthmus, and he used the above statement only as a pretext. Herodes Atticus also at one time planned this canal.

The cross-section of the canal is shown in Fig. 6. It has the same width as the Suez Canal, 75 ft. It will shorten the voyage of vessels, going from the Adriatic Sea to Turkey and Asia Minor, by 185 miles and those coming through the straits of Messina, by 95 miles. The advantages gained by this canal are therefore small in comparison to the Suez and Panama Canals; still it will be a profitable enterprise. It is estimated, that the annual traffic through the canal will amount to about 4,650,000 tons, the toll for ships from the Adriatic Sea will be one franc (20 cts.) per ton, and for those from the Mediterranean Sea, 50 centimes (10 cts.) per ton.

The Suez Canal cost about 2,743,000 frs. per kilometer (or $885,000 per mile), the estimated cost of the Panama Canal is 10,000,000 frs. per kilometer (or $3,220,000 per mile,) of which, however, 750,000 frs. may be charged to the extensive extra work, so that the kilometer of actual canal will probably not cost more than 9,250,000 frs. ($2,980,000 per mile). The Corinth Canal can be better compared with the Panama Canal than the Suez Canal, as in the latter only a low flat isthmus had to be cut, while in Panama the deepest cut is 286 ft., and in the Corinth Canal 256 ft. The masses to be moved per kilometer are larger in the latter than in Panama, on account of the wider plateau at Corinth. But the Corinth Canal can be made entirely in the dry ground, while the Panama cannot.

French capital has furnished the means to accomplish this gigantic work. The work was let to a contracting firm, for the total sum of 26,400,000 frs. ($5,280,000). Work was begun in May, 1882.

The line of the canal, as located by Mr. Gerster, is nearly the same as the one located by Nero's engineers, 35 shafts and a well-made cistern remain still as witnesses of this undertaking of the Roman Emperor.

The geological profile (Fig. 7) shows the locality of these shafts, of which No 4 is cleaned out to the line of low water, 58.88 m. (193 ft). and No 13 to a depth of 32.58 m. (106.5 ft). They are to the right and left of the present centre line, distant about 75 m. (246 ft). from each other and 40 m. (131 ft.) from the centre line.

The adopted plan of working the cut is as follows: A cut will be made by the so called "English method" from Sta. 2650 to 4750 (2100 m. = 6900 ft.), for which purpose the shafts No 1 (at Sta. 3177) to No 10 (at Sta. 4600) were sunk. The average distance between those shafts is about 150 m. (490 ft.), their depths vary from 12.97 m. (42.5 ft.) for No 10 to 27.33 m. (90 ft.) for No 5. They are all 2 m. (6.56 ft.) wide, in a line with the canal, and 3 m. (9.84 ft.) long, measured at 90° to the centre line of the canal.

At the beginning of December, 1882, 30 m. (98 ft.) of drift, 2 m. (6.56 ft.) high and 1.3 m. (43 ft.) wide, had been driven from these shafts, and at the end of January 1883, 450 m. (1480 ft.) of drift were finished. The open cut was also begun at Stations 2650 and 4800. The finished drift is then widened out to a tunnel, 3 m. (9.84 ft.) wide and 4 m. (13.1 ft.) high, so that larger cars and a locomotive can be used. The debris is dumped on the Corinth side into a little lateral valley, and on the side of Kalamaki, along the sea shore.

Meanwhile work is carried on from both ends of the canal by blasting and by excavators, to a depth of 8 m. (26.3 ft.) below low water. The drill-holes for this work are sunk down vertically to 8 m. (26.3 ft.) below low water line in rows of from 5 to 7 holes. These rows are at right angles to the centre line of the canal, and are 3 m. (9.84 ft.) distant from each other, while the single holes of each row are 5 m. (16.4 ft.) distant from each other, measured from centre to centre. The holes of one row are blasted simultaneously. If the depth of the holes is more than 15 m. (49.2 ft.) the blasting is done in several sections.

The excavators follow immediately and are continuously at work, except during the blasting, which takes about one hour per day. After the English cut between Stations 2650 and 4800 has been finished, the drilling of the bore-holes, 60 m. (197 ft.) deep by 12 machines begins: 6 of the machines commence work at Station 2400 and 6 at Station 4800 progressing towards the middle of the canal. After the blasting at the two ends has reached Stations 2400 and 4800, it will be done in 4 terraces, each being 15 m. (49 ft.) high and 3 m. (9.84 ft.) wide. (Fig. 8 a)

The plant for the drilling is as follows: At Station 5500 a well is sunk, which delivers sufficient fresh water; the same is raised by a pump with two cylinders and delivered into an accumulator with a weight of 13,000 kg. (28,600 lbs,) From the accumulator to Station 600 the water is carried by a pipe, 60, to 80 mm (2¼ in. to 3¼in.) diameter, tees with valves being put at each 50 m. (164. ft.) to allow the taking of water at as many places.

Seven tracks, 1 m. (3.28 ft.) gauge, 5 m. (16.4ft.) distant from each other, measured from centre to centre, are laid in each cut. Tracks No. 2 and 7 are used by the drills, and 3 and 5 have besides the drills, each a movable boiler of 24 H. P. Track No. 1. remains free at first. The boilers furnish steam for three drills each, which commence drilling simultaneously. The force of men employed consists of 1 fireman and 1 helper for each boiler and 1 drillman and 2 helpers for each drill; besides these there are for each 3 drills, 1 machinist and 1 foreman; 1 man has charge of the water-pipes and at the head of the whole drilling force is a mechanical engineer.

The drill on track No. 7. which bores holes of only 19.5 m. (64 ft.) depth, is pulled back 3 m. (9.84 ft.) after the first hole is finished, and then drills the second, after which it is brought upon track No. 1, there drilling 4 holes

Each drill is provided with two sets of drill-rods, so that a new hole may be commenced at once, before the rod of the first hole is raised and disjointed, by another set of men. The drilling commences with rods of 1 m. (3.28 ft.) long; after that the extension rods, screwed in, are 2 m. (6.56 ft.) long, so that for the deepest holes, 61 m. (200 ft.) drill rods are screwed together. The finished drill-holes are closed previous to loading by wooden plugs. It is to be expected that the drilling between Stations 2400 and 4800 will be finished before the two approaches from Station 0. and Station 6300 will have reached the above stations. The nature of the ground is such, that the water in the drill-holes disappears, after a few hours, in the adjoining ground. The bore-dust must therefore be washed out immediately, as otherwise the finely ground stuff would harden to a tough mortar-like substance. When the bore-holes are cleaned and dried, they are filled with fine, dry sand to within 15 m. (49 ft.) of the top.

To illustrate the method of proceeding, we will suppose that the work on the Kalamaki side had progressed to Station 2400, then the first row of holes is blasted off to a depth of 7 m. (23 ft.) above low water, the second to 22 m. (72.2 ft.) and the third to 37 m. (121 ft.) Then

* This article was compiled from M. Ed. Rada's article in "Wochenschrift des Oesterrichischen Ing. Arch. Vereins," No. 14, 1881, and from M. Hugo Münch's article in "Zeitschrift des Oesterr. Ing. Arch. Vereins," No. 5, 1883.

the first row is cleaned out by water to 8 m. (26 ft.) below low water, the second to 22 m. (72.2 ft.) and the third to 37 m. (121 ft.) The powder is enclosed in water tight cases, made from prepared parchment paper. Each cartridge consists of 12.1 kg (26.6 lbs.) dynamite No. 1; it has a diameter of 85 mm. (3⅜ in.) is 1.5 m. long (4.92 ft.) and contains one primer with a fulminate cap of 0.6 gramm. (0.021 oz.) Each bore hole is charged with three such charges, the lowest at the bottom of the hole, the second at 4.75 m. (15.6 ft.) above the first and the third at 2.5 m. (8.2 ft,) below the upper edge of the hole, each separated from the other by dry beach sand, which is also used for tamping, being admirably adapted for this use. (Fig. 9.)

The five holes of the lowest terrace, the five holes of the second, the five holes of the third terrace and the first row of the seven holes in the bottom of the cut are each loaded with three such separated charges; but the end bore-holes of the third terrace are loaded with only one charge. They are therefore:

I terrace,	5	drill-holes each	3	charges	=	15	charges.
II "	5	"	3	"	=	15	"
III "	5	"	3	"	=	15	"
	2	"	1	"	=	2	"
IV "	7	"	3	"	=	21	"
Total.....						68	charges.

Each of 12.1 kg. (26.6 lbs.) or, altogether, 822.8 kg. (1,810 lbs.) of dynamite No. 1. All the holes are blasted simultaneously by electricity.

As the lower cut is 60 m. (197 ft.) deep, 22 m. (72.2 ft.) wide in the bottom and 34 m. (111.3 ft.) at the top, and as the charges have 3 m. (9.84 ft.) of ground before them, the amount of rock, loosened by one blast, will be $60 \times \frac{1}{2}(22+34) \times 3 = 5{,}040$ cu. metres or 6,600 cu. yds. Therefore we have per one cu. meter of rock about 163 gramm. dynamite No. 1, 0.0135 electric exploder, and 0.1 m. wire (or per 1 cu. yd. of rock, 4.4 oz's of dynamite No. 1, 0.0103 electric exploder and 0.25 ft. of wire). At each terrace there are employed, for blasting, one foreman and four blasters, therefore for all four terraces, four foremen and sixteen blasters, over all of which is one general foreman. The time for blasting is on an average every 2½ hours. Experimental blasts have shown that 12.1 kg. (26.6 lbs.) of dynamite No. 1, with a hole 3.6 m. (11.8 ft.) deep and 3 m. (9.84 ft.) ground in front of it, throws out a cone of 3 m. (9.84 ft.) radius. It, therefore, would be correct to locate the holes 6 m. (19.7 ft.) apart and also to keep the single charges 6 m. (19.7 ft.) apart from each other, but as a most complete breaking of the rock was desired, the distance was fixed at 5 m. (16.4 ft.) The central mass to be blasted is 2,400 m. long (7,880 ft.) requiring 800 rows of drill-holes, *i. e.*

4,000 holes, each 60·0 m. (197 ft.)=240,000 m. (788,000 ft.) long
1,600 " " 19.5 m. (64 ft.) = 31,200 m. (102,250 ft.) "
Total 5,600 holes with a total length of 271,200 m. (890,250 ft)

As each 60 m. deep hole can be drilled in 15 hours, *i. e.*, in one day, and as the work is carried on from the two ends with six drills at each, the drills on the track 1, 7 respectively drill, 800 holes, each 19.5 m. (64 ft.) deep, one drill has to make 400 holes, which will require one year and four months, counting twenty-five days for one month.

The total mass of rock between the Stations 2,400 and 2,800 amounts to $2{,}400 \times 60 \times 28 = 4{,}032{,}000$ cu. metres (5,280,000 cu. yds.) requiring 54,400 charges of 12.1 kg. (26.6 lbs.) each, or together 658,240 kg. (1,460,000 lbs.) of dynamite, 54,400 electric exploders and 403,200 m. (1,330,000 ft.) of wire.

As the blasted rock is taken away by large excavators, it must be broken up into sufficiently small pieces (0.75 cu. metre = 1 cu. yd.) The total mass to be moved in the entire canal is:

a. the English cut.....	920,000	cu. m.	(1,210,000 cu. yds.)
b. from sect. 0 to 2,400.	1,650,000	"	2,170,000 "
c. from sect. 4,800 to 6,300.	790,000	"	1,040,000 "
d. the central mass from 2,400 to 4,800,	4,032,000	"	5,310,000 "
Total.....	7,392,000		9,730,000 cu. yds.

Of which 6,242,000 cu. m. (8,200,000 cu. yds.) are above low-water, and 1,150,000 cu. m. (1,530,000 cu. yds.) below the same. The two approaches from Stat. 0 to 2,400, and from 4,800 to 6,300, require about 4,200 drill holes with an aggregate length of about 240,000 m. (787,000 ft.)

The consumption of dynamite for the whole canal is estimated as follows:

a. for the English cut (per cu. yd., 0.062 oz's.)=	465,000 lbs
b. for the cut f.om 0 to 2,400, about 1.315.000 cu. yds., 0.0373 ozs. =	353,200 "
c. for the cut from 4,800 to 6,300, about 525,000 cu. yds., 0.0373 ozs. =	143,400 "
d. for the central mass as above =	1,445,000 "
e. for quarries, etc =	48,250 "
Aggregate..... =	2,460,850 lbs

The time for finishing the work is four years from the day of commencement of the work by the contractors. The contract price for running foot of shaft is $3.26, $3.80; the contract price for running foot of tunnel is $1.90, $2.17, including hoisting and transportation to a distance of 50 m. (164 ft.)

As an addenda to the above interesting compilation of Mr. Specht, we give some further notes from the *Bulletin du Canal de Corinthe*, to February 1884, kindly sent us by Mr. Colné, of the Inter-oceanic Canal Co.

The method proposed by M. Bobin, engineer of the company, for removing the material, may be outlined as follows: The approach from deep water, a distance of about 600 ft. on each side, and the alluvial deposit will be removed by the use of land excavators, Priestman dredges, and Ball pumps. The total cube of this material is 3,330,000 cu. yds., and this portion of the work is practically completed. The Priestman dredge mentioned is evidently a species of "dipper" or "clam-shell" dredge, and is reported as raising 500 to 600 tons (2,200 lbs. to a ton) per day of 12 hours, at a cost of about 18 *centimes* (3½ cent) per ton, for mud. The machine is provided with both buckets and claws, so that it may operate either in mud or loose rock. The Ball pump is used in excavating sand, and raises 2,300 to 2,600 cu. yds. "per day."

In attacking the main cut, a tunnel is first driven through the mass at a point 47 m. (154 ft.) above the sea level. Vertical shafts will then be sunk to the level of this tunnel, which is wide enough for a double line of rails, and these shafts will be widened out from the top on the line of the axis of the canal, and the excavated material thrown down the shafts to the trains beneath, which last will remove it to some of the valleys adjoining the line of the canal. According to the cross-section shown, a central mass of rock seems to be left in the tunnel between the lines of track, and on top of this is a shute to break the fall of the material and divert it into the cars. This detail is not fully explained in the text. This upper cut is supposed to contain 2,700,000 cu. yds., and two years will be required to remove it.

The solid cube left below the line of the tunnel will be excavated by drills and dynamite, working it in benches. It was proposed to use here the Taverdon drill, with which holes 160 ft. deep and 4 in. in diameter could be drilled, reaching to the bed of the canal. The holes will be spaced from 6 ft. to 13 ft. apart according to the density of the material. The rock is supposed to be broken to about the size of a "man's head," and cast down into the bed of the canal already excavated, when it will be picked up by powerful dredges, designed for this purpose, and discharged into barges; the latter to be towed to sea and there dumped.

The contractors estimate that the average price of excavation will not exceed 2 *francs* (40 cents) per cubic *metre* (1¼ cu. yds.). This price to include all manual labor, fuel, general expenses of all kinds, and the first cost of the dredges, barges, tugs, etc., which according to the contract must be handed over to the company, upon the completion of the work, without further compensation.

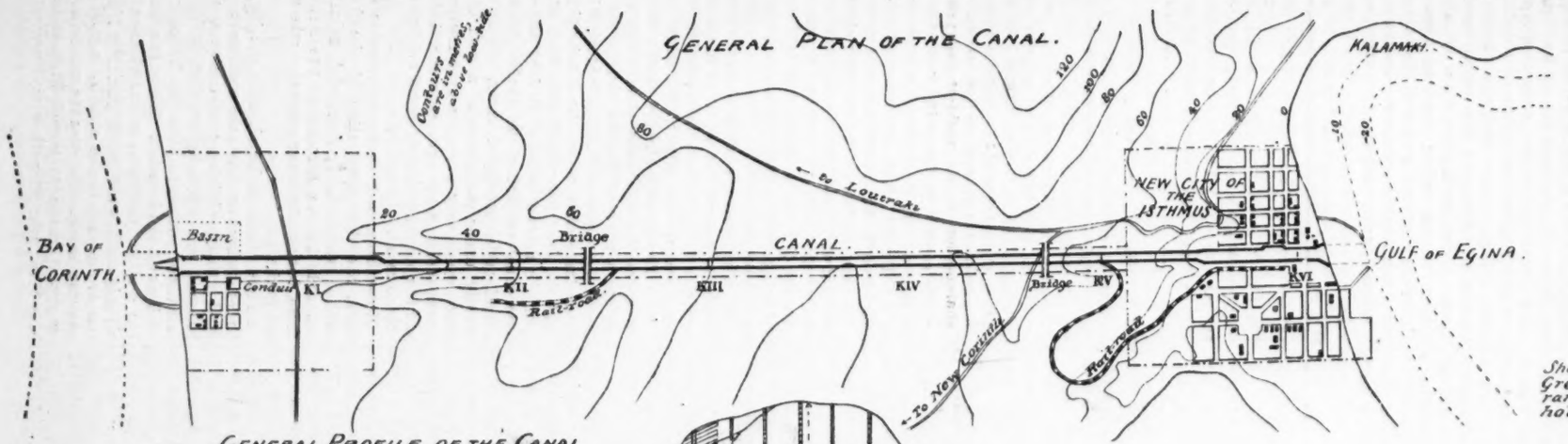
In addition to the plant already mentioned, there are two medium dredges, built by Schimmelbusch of Vienna, and two powerful dredges for removing rock, built by Demange & Sâtre, at Lyons, France. The smaller dredges are each 98⅛ ft. long, 20⅛ ft. wide, and draw 5 ft. of water. They are provided with 29 buckets, of a capacity of 9⅛ cu. ft. each, these machines average 2,000 cu. yds. per day of 24 hours.

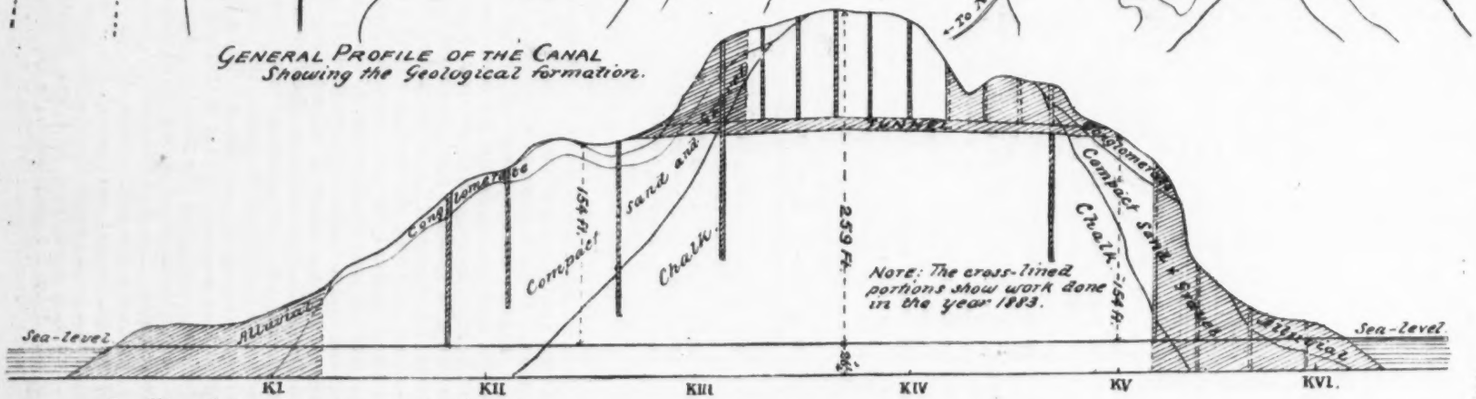
The large dredges, the first of which, the "Isthmia," was tested on the River Soane, in France, on Jan. 22, 1884, have a length of hull of 129 ft., and are 31.16 ft. wide. Each bucket contains ⅛ cu. yds. (700 *litres*) and the normal running speed is 14 buckets per minute, or 8,400 buckets per day of 10 hours. This is equivalent to 7.687 cu. yds. per day, though the average work for 10 hours in gravel, in the Soane, was 6,500 cu. yds. The machinery is run by two coupled engines of 150 H. P. each. According to a photograph in the possession of Mr. Colné, these French dredges are compact and powerful machines, the hull being of iron, as is also the frame work and bracing; the hull is divided at the bow for the manipulation of the bucket arm and the chain of buckets. The material excavated is diverted by a central apron and shutes to either side of the dredge, where it passes into barges which are towed to sea as fast as they are filled.

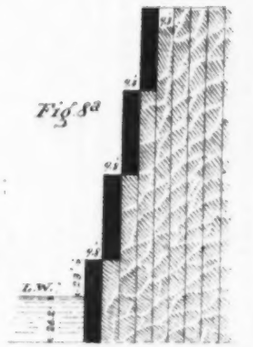
American Securities Abroad.

The following is taken from the London *Spectator* of May 17:

"The intolerable tolerance of American feeling towards speculators greatly increases the risk in investing in American bonds. No president of a railroad is ever punished either for misrepresentation or for committing his shareholders to the maddest enterprises. If he succeeds he is considered a great man, and if he fails he is pitied, and sometimes presented with great sums to live on. Even the president of a bank is not held criminally liable for loans to his own relatives without security, if only his friends, when he has failed, will pay up his defaults. The manager of a deposit bank who uses deposits to buy "blocks,' of shares is, if the shares rise, considered clever; and if they fall and he fails, is, after the first twenty-four hours, neither considered nor treated as a mere thief. If he is well connected, or popular, or sheltered by friends, his 'ruin' is regarded as a sufficient penalty, and after a year or two of retirement he usually begins again. The effect of this is, that any person who can obtain the control of large funds is tempted to make himself rich at once, and that the market is always at the mercy of men who are playing a game in which they stake temporary inconvenience and disrepute against fortune. The temptation is too great for a race of men who care more to gain money in large sums than any people in the world, and at the same time fear poverty less than any other people. Millionaires in America make 'corners' as if they had nothing to lose, or let their sons amuse themselves with 'financing' as if it were only an expensive game. An Englishman, however speculative he may be, fears poverty excessively, and a Frenchman shoots himself to avoid it; but an American with a million will speculate to win ten, and if he loses take a clerkship without thinking much about it. There is a good side, a very good side, to the 'detachment' noticeable in all American business men, a freedom from sordidness and from petty grasping; but the peculiarity makes them the most dangerous business gamesters in the world. You know in dealing with a Frenchman that he will not voluntarily risk pecuniary ruin, but to an American that risk rather adds to the excitement of his pursuit. What, indeed, is ruin, in that exhilarating air, with nobody caring, and thirty-six States around you offering to the skillful 36,000 ways of making money? An attack of dyspepsia is far worse; and, in fact, when a prominent American is ruined, we generally hear that he is 'sick,' and that his friends upon that account are full of anxiety for his future."







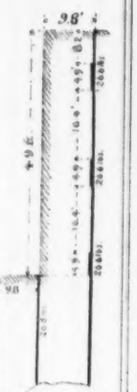
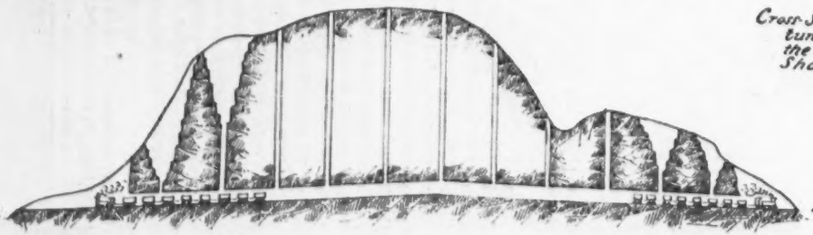
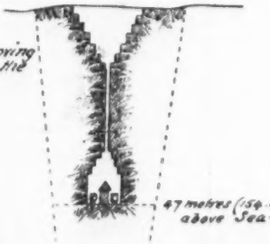
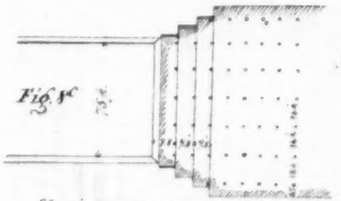


Fig. 9
Showing distribution of Cartridges.



Cross-Section, showing the tunnel and trains for removing the material thrown down the Shafts.





THE CORINTH CANAL.

Shaft-Sinking by Freezing. The Pœtsch Method.*

This new system of shaft-sinking in water-bearing soils, differs from all other known methods, in the transformation of this soil from a liquid to a solid state; instead of the usual attempt to drain the shaft by pumping.

The necessity for a pumping plant is avoided, and the danger, as well, from the fluid condition of the surrounding ground. The sinking is carried on as in solid ground, and there is no fear of pressure upon the sides or from the bottom of the shaft, because the soil forms one homogeneous mass, and slips are impossible.

M. Pœtsch solidifies the fluid soil by congelation, brought about by sinking a system of tubes in which circulates a saline solution of very low temperature. By this simple method he reduces the temperature of the earth to 19° Cent. (22° Fahr.) and gives it the solidity of sandstone, a conchoidal fracture, and all the properties of stability due to a mineral substance.

Before putting this process into practice, (it is patented in Europe and the United States) M. Pœtsch made the following experiments: He poured into a box, placed upon the surface of the ground, about 5 cu. yds. of semi-fluid earth; in this box was arranged a system of pipes, connected with an ice-machine. Through these pipes a saline freezing solution was circulated, and by means of a thermometer, the temperature was obtained at varying distances from the pipes. At the end of eight days, the entire cube of earth was frozen solid, and when the sides of the box were removed, the mass resembled sandstone in its hardness. Some of the pipes used were made of copper, others of iron; the inventor found that while the copper pipes were superior to the iron, in conducting cold, at the end of five days the congealed portions were as thick around the iron pipes as around the copper, and the temperature was the same. These results accord with the experiments of Dr. Reincke and H. Pauksch, in testing the relative heat-conducting power of copper and iron.

This first attempt having demonstrated the possibility of realizing his idea, the inventor decided to test the method upon a grander scale. The Douglas Company, at Aschersleben, graciously put at his disposal the Archibald lignite mine, near Schneidlingen.

A shaft, with a rectilinear section of $15\frac{44}{100} \times 10\frac{3}{10}$ ft., had been sunk through $101\frac{1}{2}$ ft. of solid earth, and was only separated from the underlying bed of lignite by a water-bearing stratum, 18 ft. thick. An attempt had been made to pass this by sheet-piling, but it had been found impossible to sink more than 4¼ ft. below the line of the water. To furnish an outlet for the incoming water, a drill-hole had been bored, in the center of the well, to the lower galleries already driven in the seam. The effect of this hole was to create a continuous current of water, which made the freezing method much more difficult of execution.

M. Pœtsch sunk, to the bottom of the shaft and about 20 in. into the lignite, 23 pipes, each 0,200 m. (7⅞ in.) in diameter; 10 of these pipes were placed against the sides of the shaft. They were fitted at their lower end, and inside, with a conical coupling, in which was placed, from above, a wooden plug shutting the pipes at the bottom. This joint was made perfectly tight by pouring in at the bottom of the pipes, successive layers, of 2 in. thickness each, of cement, plaster and moistened clay, the whole covered by a bed of asphalt and an iron washer, properly adjusted. In the interior of these pipes were placed other pipes, 30 millimetres (1.18 in.) in diameter, open at the lower ends and held in place by tubular fitti gs and stuffing boxes at the upper ends. The inner pipes communicated with a common pipe at the upper ends, and another pipe connected all the outer tubes. The saline solution was driven into the inner pipes and ascended in the annular space around them, and this in circulating lowered the temperature of the surrounding soil. This system of pipes communicated with a Carrè ice-machine, placed upon the surface of the ground above, by means of two pipes, one of which, connected with the inner tubing, carried off the cold liquid leaving the machine and forced downward by a pump, and the other carried back to the refrigerator the liquid which had passed through the circuit.

The saline solution used had a base of chloride of calcium, of which the freezing point is at 40° Cent. below zero, or 40° below zero Fahrenheit.

So as to be able to observe the temperature of the earth, 20 pipes were sunk at the bottom of the well and near the sides, at different points, near the freezing-pipes. These pipes, 20″ in length and of small diameter, were closed at the bottom and filled with a solution of chloride of calcium; they were fitted to receive a thermometer. Observations were made daily.

We confine ourselves to giving the results of the daily observations, made to obtain the relative temperature of the air at the bottom of the shaft, and in the four thermometric tubes placed in the sides of the shaft and as near as possible to the pipes of congelation.

The observations made on July 8th give the initial temperature of the air and the sides at the bottom of the shaft, before the apparatus was put into operation. The figures give the temperature in degrees Fahrenheit.

The very low temperature at the bottom of the shaft, during the last few days, was very apparent as soon as an observer decended. When he remained some time at the bottom, the temperature of the air gradually rose, and when, as during the sinking, several miners were constantly at work there, the temperature was maintained at from 0.5° to 1° Cent. The workmen were not inconvenienced by the cold; on the contrary, it had a bracing effect. During the sinking, which was done between the freezing-tubes, the process of congelation was kept up. The shaft, by reason of this freezing, was perfectly dry, and the once fluid soil was as hard as sandstone; the sinking was done, consequently, with the pick, point and hammer, without the use of sheet-piling of any description. The shaft was timbered, however, for each metre (3.28 ft.) sunk. On September 30, 1883, the coal was reached, this also had frozen to the depth of one *metre* below the pipes, the overlying sand was thoroughly united by the congelation, to the coal beneath, in such manner that fragments detached by the pick were partly coal and partly frozen sand; separation rarely took place at the plane of contact of the two materials.

When the sinking was completed, horizontal trenches were cut, about 20 in. above the coal, out into the congealed earth. It was proven by an examination with the thermometer, that the ground was frozen around each pipe in a circle of about 5 ft. in diameter. Other measurements demonstrated the fact that the thickness of the block of ice increased with the depth. This is naturally to be expected, when we reflect that the congealing liquid is poured out from the bottom of the interior tubes, and exerts its maximum effect at the base of the pipe. By this action, there was formed around each pipe, not a cylinder but a cone of ice having the base downward. Under the prolonged action of this cold, these cones first increase in their dimensions, then touch and finally penetrate each other, ending by making of the soil one solid frozen mass. This explains why the hardness of the frozen earth increases with the depth.

Based upon the result obtained, we can readily see that in a shaft of circular section, a thickness of one metre (3.28 ft.) of frozen earth in the sides would permit the sinking of two metres (6.56 ft.) without timbering.

We have mentioned that the shaft had been already sunk 4¼ ft. below the water line, and put into communication with a lower gallery by a drill hole. This fact had the following injurious effects upon the congelation process:

1st. One portion of the freezing pipes, the length of which had been fixed from the thickness of the fluid material to be penetrated, stuck up 4¼ ft. above the bottom of the shaft, and being situated in the open air, chilled this air and not the earth.

2nd. The running stream of water from the bore hole, caused the waste of much of the cold, this water, in fact, while running, fell, in temperature, from +11° to +2° Cent.

3rd. The ground already frozen was constantly met by this water at 11° Cent., retarding much the solidification outside the shaft and in the upper part of the congealed block. It was impossible to stop the flow by plugging the hole, for there would have been at once formed a mass of water 4¼ ft. deep and with a base equal to that of the shaft. This very considerable quantity of water, in congealing rapidly under the action of a cold of —20° Cent., would very probably have exerted, by its expansion, a pressure upon the timbering and the pipes which they would not have been able to resist.

Notwithstanding these unfavorable conditions, the first application of the Pœtsch method was perfectly successful, as attested not only by the Director of the Archibald Mine, but also by many engineers who visited the works.

In new works undertaken by the inventor, he commences by filling the shaft to the water level with gravel, in case previous sinking has brought the work below that level. The method of putting in place the freezing pipes varies with the location. When the fluid soil has a slight thickness only, and the shaft is already sunk to the water level, the pipes are simply forced into the sand by a sand pump working inside. This was the system actually employed at the Archibald Mine and at the Max Mine, near Michalkowitz (Upper Silesia).

Date: July, 1883.	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Temperature of the air at the bottom of the Shaft	+53.6°	42.8°	32°	30.2°	29.3°	30.2	28.4°	29.3°	29.3°	28.4°	28.4°	26.6°	27.5°	27.5°	24.8°	24.8°	23.0°	23.0°	22.1°	22.1°	22.1°	21.2°	21.2°	21.2
Temperature of the ground, East side	51.8	43.2	28.4	26.6	26.6	24.8	23.0	21.2	21.2	20.3	16.7	17.6	12.2	9.5	8.6	6.8	5.0	5.0	3.2	3.2	—0.4	—1.3	—1.3	—2.2
Temperature of the ground, South side	51.8	44.6	26.6	25.7	25.7	24.8	23.0	23.9	23.9	23.9	19.4	15.8	9.4	6.8	4.1	1.4	0.5	0.5	1.4	1.4	1.4	0.5	0.5	0.5
Temperature of the ground, West side	51.8	43.2	28.4	26.6	25.7	24.8	21.2	23.0	23.0	17.6	12.2	14.0	9.4	8.6	6.8	6.8	5.0	1.4	1.4	0.5	—0.4	—0.4	—2.2	—2.2
Temperature of the ground, North side	51.8	44.6	26.6	24.8	24.8	23.0	21.2	18.5	18.5	17.6	13.1	13.1	12.2	9.4	9.5	8.6	6.8	1.3	1.3	1.4	1.4	1.4	—0.4	—0.4

NOTE: The *Minus quantities* are *below* zero, Fahrenheit.

*Translated for ENGINEERING NEWS, from *Zeitschrift für Berg., Hütten., und Salinenwesen in Preussischen Staate.*

When the force of the liquid soil is considerable, a boring machine is used which puts down four pipes at a time, and is worked by the Schonebeek water-jet system. If the fluid soil is not at a great depth below the surface, the holes for the pipes are bored from the surface, and the pipes are arranged in such a manner that a shaft of the desired dimensions can be sunk inside of them. But when thi; water stratum is at a great depth, and the sinking of the holes would be too costly, the shaft must first be sunk to water level with a diameter about one *metre* greater than the finished diameter; this larger shaft is timbered and the freezing pipes sunk inside.

If the water-bearing stratum encloses boulders, etc., of considerable dimensions, the holes are either inclined to avoid them, or they are removed altogether, or they are pierced through by special apparatus.

In comparing finally the Pœtsch system with previously known methods of passing fluid soils, we are forced to admit that this alone permits an accurate previous estimate of cost and time of sinking. The principal advantages are:

1st. The assurance of a perfectly vertical and rapid sinking of the shaft; as if the work was done in solid ground.

2nd. An absolute guarantee of the cost of the plant.

3rd. Pumping machinery is not required.

4th. It does away with any difficulty from meeting inclined strata of fluid material, since all the beds passed are converted into a single block of ice.

Iron and Steel Permanent Way.*

The first paper on the list was one by Mr. Walter R. Browne, "On Iron and Steel Permanent Way." He commenced by referring to papers on this subject, which had been contributed by Herr Gruttefien, at the Düsseldorf meeting of the Institute in 1880, by Mr. Charles Wood, read before a meeting of the Institution of Civil Engineers, and to a paper by Mr. Price Williams, read before the Iron and Steel Institute in 1881. Although these papers had tended to throw a good deal of light on the question, so far as the author was aware the result had not been to advance in any appreciable degree the substitution of metal for wood as a material for sleepers on English railways. The author referred to the progress that the introduction of metal sleepers had made in Germany. The points that most required attention were whether the metal used was to be iron or steel, whether the sleepers were to run lengthwise or crosswise, and what is to be the particular mode of fastening for uniting them with the flat-footed rail which is the general type on the Continent? These points, however, referred to Continental practice; what the author wished principally to deal with was the introduction of iron or steel sleepers into England. The first consideration was that the new sleeper should be able at once and without inconvenience to replace the old one. With one exception the main lines in England are said to be laid with double-headed rails in cast-iron chairs resting upon a transverse sleeper, and the iron sleeper should be one that would readily replace the existing wooden one, and the same rails, and if possible the same chairs, should be retained. The results of the experience in Germany, Mr. Browne considered, enabled him to make the following statements with confidence:

Firstly, that the corrosion of the sleepers is insignificant.

Secondly, the elasticity of the road is perfectly satisfactory.

Thirdly, although the connection of the rails to the sleepers has proved a matter of some difficulty, satisfactory results have at last been obtained. This point, however, did not bear so much on the question under discussion, as the double-headed rail, which must necessarily be secured in chairs, is the type in use in this country. In Germany the point which has given most trouble, is the endways shifting of the sleepers when laid upon sharp curves. Wooden sleepers offer greater resistance than iron to endways motion; as their weight is greater their ends have a much larger area to bear against the ballast, and their co-efficient of friction is higher. Vibration and churning of water below the sleepers often produces a layer of greasy mud beneath them. In Germany, they either bend down the ends of the sleeper, or rivet angle irons or dividing plates to its bottom; it has also been suggested to put the sleepers in pairs crossing each other, in the form of a St. Andrew's Cross; but this involves complication. Mr. Wood had called attention to the greater length of sleepers on English than Continental railways, 9 ft. and 7 ft. being their respective lengths. Assuming a shrinkage of ballast under the rails, the short sleeper is more likely to shift than the long one. English railways have also an advantage in the more gritty nature of the ballast which does not form into mud. Some wrought-iron sleepers laid in South Wales on a curve having a radius of only 10 chains, and on a gradient of 1 in 40, are reported to show no signs whatever of endways slipping. These sleepers, constructed from the designs of Mr. F. W. Webb, of the London and North-western Railway, were illustrated by drawings hung on the walls of the hall. In cross section they are the same as those introduced by Vautherin[1] twenty years ago, excepting that the feet are narrower. These sleepers are rolled from Bessemer steel ingots 10½ in. square in a three-high mill, and come out as bars 60 ft. or 70 ft. long, which are afterwards cut into lengths. They are then punched with six holes for the chairs, the holes being punched from both sides, so as to make them slightly tapered in the middle. The chairs are of steel stamped out in a die under a steam hammer. A lining plate, placed between the chair and the sleeper, is also of steel: it is sawn up hot into proper lengths. Liners of brown paper soaked in tar also inserted so as to prevent any possibility of shaking loose or chattering. All parts, chair, lining plate, liners, and sleeper, are rivetted together by a Tweddell hydraulic rivetter, and the moment this is completed the distance between the rails is absolutely fixed. The keys used are of the ordinary type, and are never found to work loose. This is partly attributed to the elasticity of the steel chair, and partly to the wood swelling out and filling a recess in the chair. The weight of the whole is 174 lbs. The weight of a London and North-Western creosoted wooden sleeper with chairs, spikes, screwed spikes, and felt liners is 242 lb. Mr. Webb's figures show that the wooden sleeper is somewhat cheaper, but probably the cost of the steel sleepers will decrease, whilst the tendency of the wooden sleepers is upwards in respect to price. The author then spoke of the uncertainty of length of life of a wooden sleeper, but thought fifteen years might be considered a favorable average. But with Mr. Webb's steel sleepers he did not think it the would be possible to lay down any definite limit of life. Amongst other advantages of system mentioned was one which seemed to appeal more especially to the sympathies of the meeting. Mr. Browne pointed out that the substitution of steel sleepers would give employment to the capital and labor of our own country now suffering under so severe a depression. The author mentioned that 40,000 of these sleepers were now in use, and some of them have been down for a period of three years. Referring to the fact that the introduction of the system he was advocating into this country was so slow, he quoted a remark that had been made by an eminent engineer who had congratulated English engineers on the caution whereby they escaped failures that were often experienced elsewhere. The author thought that it was not to be wondered at that the industries of England are threatened with ruin if English engineers have thus begun to take pride in being in the rear of progress.

The discussion which followed the reading of this paper was of an interesting nature. After a few words from Mr. Macnee, Mr. Chas. Wood, of Middlesbrough, said that he had little confidence in the manner described by which the chairs were rivetted to the metal sleepers; in fact, he was not in favor of any rivetting work in this connection at all, and bolts and nuts should not be employed in such a position. He felt sure that by the chattering of the heads of the rivets they would work loose and in time come right through. Mr. Browne in the instances quoted had acknowledged that some of the rivets worked loose, and that, he (Mr. Wood) considered went to the root of the whole matter; for no amount of hydraulic rivetting nor any quantity of brown paper would keep out the wet. He spoke from practical experience, and could show specimens which would substantiate his remarks. There was one point he would like information upon. It had never been satisfactorily explained to him how it was that sleepers were supposed not to corrode when in use, although they would do so if lying idle. Some attributed it to the rails being magnetised by the jarring set up by the passing traffic, and no doubt a certain amount of magnetism was so set up, and magnetic oxide, it was well known, was a good preservative of iron. Mr. Wood, however, thought it was rather to be attributed to the fact that by the working of the surfaces any coating of rust was worked off. He had seen rails that had been lying out in the open air coated with a scale one-sixteenth of an inch thick, and invariably under this there was a film of moisture. The rapid deterioration that would go on in such a case was obvious. The speaker then dwelt somewhat fully on the effect that the length of sleepers had on the displacement of ballast, illustrating his views by means of the blackboard. He referred to the sleepers that had been laid down on the North-eastern Railway. These were rolled from puddled bars. They were down for five years and were then taken up. They did not break across the line of holes, but simply cocked up at the ends, and this was the reason that they were removed. Mr. Webb had been more fortunate in the material he had used, which was steel. The speaker exhibited a model of the spring clip he used in connection with a flat-bottom rail, and pointed out that an additional stability of 2½ per cent. was obtained with that type of rail. He considered that a saving of 6d. a yard in labor would be obtained with the steel sleepers; they were easily packed, but the ballast required to be well drained. Recurring to wooden sleepers, he said that they might be laid for thirty years and then be taken up quite good, and he further considered that the great reason that the English lines possessed such a magnificent permanent way, unsurpassed by any in the world, was that such an ample base was given to the chairs. He thought that the short life of sleepers in India was to be attributed to their inferior creosoting.

Mr. Jeremiah Head, who spoke next, stated he had seen the iron sleepers supplied by Mr. Wood to the North-Eastern Railway, and he bore testimony to the easy way in which the trains ran over them, while he remarked on the wave form assumed by the rails under the passage of a train. He saw no corrosion in these sleepers except where surfaces came together. He would suggest that the sole-piece which Mr. Webb added for strength in his sleepers should be made longer. With regard to slipping, the platelayers had told him there was no slipping with Mr. Wood's sleepers, but

*Before the Iron and Steel Institute; London, April 30, 1884.

[1] For the Vautherin and other types of Continental ties see ENGINEERING NEWS of May 8, 1884, page 111.

they were more difficult to ballast. He also referred to the great benefit that would accrue to the steel trade if steel sleepers were to be introduced.

Mr. Markham spoke of the advantages of the Barlow rail, which he thought might turn out to be the rail of the future. He was afraid that in the arrangement described by Mr. Browne the rivets might give way after a time.

Mr. Charles Wood rose again and said that the weakness in the Barlow rail was in the joint. He also referred, in connection with a remark made by another speaker, to the perfectly plain plate sleepers which his firm supplied for use on the Spanish railways. Mr. Williams followed and pointed out the defects that were caused in a Barlow rail through the difficulties in rolling owing to the unequal travel of the parts. Thus supposing the rail were 6 in. deep and one roll 25 per cent. larger than the other, the layers forming the head of the rail would slip. If, however, the Barlow rail were rolled from a steel ingot it would make a splendid job.

The President, Mr. B. Samuelson, M.P., in summing up the discussion referred to the vast field there is for railway work in India. In a few telling sentences he warmly resented the imputation that had been cast upon the enlightenment and enterprise of English engineers by the author's paper. He did not think they were by any means behind their foreign compeers.

Mr. Browne, in reply to the discussion, referred to Mr. Wood's remarks on the subject of vibration and its effect on corrosion, and to the probability of rivets getting loose. He thought that Mr. Wood's clip might have advantages, but the experience in Germany had not been altogether favorable to clips. He preferred the method he had described, especially when it was remembered the good work that could be done by hydraulic rivetting when it was carried on in the shop. With regard to the strain on the sleeper, a point which had been referred to in the discussion, he did not think it of such great importance as the probability of fracture was so remote as not to be worth considering. The statement Mr. Wood has made, that a saving of 6d. per yard in labor was obtained by the use of metal sleepers, had surprised him very much. If this were really a fact, it would make a steel laid road cheaper than the ordinary kind.—*Engineering.*

Narrow-Gauge Railroads.

In reply to an inquiry that was made by some reader, the New York *Herald* has the following to say regarding narrow-guage roads: "Narrow-gauge railroads have proved a failure in many of the Western States, because the standard gauge has become so firmly established in this country. I suppose the narrow gauge will gradually disappear in the same manner as the broad six-foot gauge has, or as the broad gauge so generally in use throughout the south a few years ago is disappearing. The standard gauge is an accident which has been favored by circumstances. But the narrow gauge has especial advantages in mountainous districts, such as that which the Denver and Rio Grande traverses, which will always maintain it there. The comparative cheapness with which a narrow-gauge road may be built and maintained for local travel has caused the construction of miles of railroad that would otherwise never have been built. It has been an important agent in opening the interior of Ohio, Indiana and Illinois, and many of the lines have since been changed to the standard gauge. The Toledo, Cincinnati and St. Louis system of more than 500 miles is now about to go through this change to accommodate through business, but this line would not have been in existence now but for the narrow-gauge."

The Institution of Civil Engineers.

At the ordinary meeting on Tuesday, May 6, Sir J. W. Bazalgette, C.B., president, in the chair, the paper read was "On the Antiseptic Treatment of Timber," by Mr. S. B. Boulton, Assoc. Inst. C. E.

The author commenced by referring to a paper by his late partner, Mr. H. P. Burt, Assoc. Inst. C. E., on the subject of timber preserving, which had been read at the Institution in 1853. Since that date the use of antiseptics for the treatment of timber had greatly increased. The process called creosoting, or the employment of the heavy oils of coal-tar, had almost entirely displaced the other methods, while the manufactures connected with the residual products of gas-making, from one of which residuals the creosote oils were derived, had experienced an enormous development. The author's connection, during thirty-four years, with this group of industries enabled him to offer the results of some personal experience and research, which he presented, together with those arrived at by other investigators.

An historical description of the antiseptic treatment of timber was preceeded by a few notes on the methods pursued by the ancients for the preservation of wood and other perishable materials. The ancients were well acquainted with the manufacture and use of many kinds of oils, tars, and bitumens; and frequently used them for the preparation of wood, with respect to which some notable instances were cited. The methods employed by the Egyptians in embalming their dead were dwelt upon at some length, and the author endeavored to elucidate some discrepancies in the descriptions of these processes, as recorded by Herodotus and Diodorus Siculus. The researches of Pettigrew were alluded to, particularly his interesting experiment upon the heart of a mummy, which after three thousand years' preservation, began immediately to putrefy when the antiseptic substances were removed by maceration. This appeared to prove that no chemical transformation had taken place, but that the long immunity from decay had been the result of the abiding presence of the antiseptic.

The growth of theories upon the causes of putrefaction was traced down to the commencement of the present century, reference being made to the "phlogiston," and other exploded theories; also to the opinions of Macbride, Sir Jno. Pringle, Sir Humphrey Davy, Thomas Wade, and others, and to their suggestions upon timber preserving. The progress of timber preserving during the railway era, and particularly between the years 1838 and 1853, was described with especial reference to the competition between the four most successful of the processes. These four consisted in the employment of corrosive sublimate, sulphate of copper, chloride of zinc, and heavy oil of coal-tar, which had been patented in England respectively by Mr. J. H. Kyan, M. J. J. Lloyd Margary, Sir William Burnett, and Mr. John Bethell.

The distinction was pointed out between the real creosote, a product derived from the distillation of wood, but which had never been employed for injecting timber, and the so-called creosote which had been so successfully used for that purpose; the latter being a heavy oil produced from the distillation of gas-tar. The theory that certain antiseptics preserved timber by coagulating the albumen, and by forming insoluble combinations with the woody fibre, had been advanced on behalf of all the four processes alluded to. But in spite of some acknowledged success, the Kyanizing, Margaryzing and Burnettizing systems were not found to be so durable in their effects as creosoting. Indeed the salts of metals were gradually washed out of timber exposed to the action of water. On the other hand the success of the creosoting process became completely established.

In order to show the process of manufacture of the creosote oils, a short description was given of the ordinary methods of tar-distilling. Coal-tar, a black viscous substance, was a residual product of gas making. It was split up by a preliminary process of distillation into three groups of substances, namely:

1. Oils lighter than water, containing the naphthas, benzoles, toluols, and other bodies, from some of which the aniline dyes were manufactured. This series of oils had never been used for timber preserving.

2. Oils heavier than water; the dead oils or creosote oils of the timber yards. These oils contained a great variety of different bodies, the properties of some of which were described, including carbolic acid, cresylic acid, naphthalene, anthracene, crysene, pyrene, quinolene, leucoline, acridine, cryptidine, etc

3. Pitch, the residium of the distillation.

The creosote oils varied in their characteristics in different districts, according to the nature of the coal used in the gasworks, and to the varying temperatures at which the coal was carbonized. The type of creosote called "London Oil," made from the tars derived from the coal of the Newcastle district, was contrasted with the so-called "Country Oil," typical of the product from the tar of the Midland and other coals. The former contained less of the carbolic and cresylic acids than the latter, but more of the semi-solid substance, which solidified within the pores of the timber, and more of the antiseptics which did not volatilize except at exceedingly elevated temperatures. The history of the controversy as to the respective merits of the two types of creosote oils was fully gone into. The carbolic and cresylic acids have been recognized as potent antiseptics; their presence appeared to arrest the action of all destructive germs, and the lighter and thinner country oils, which contained a comparatively large percentage of these tar acids, had, therefore, been preferred by many. The opinion of Dr. Letheby to that effect was recorded. On the other hand, were cited the opinions and practice of the introducers of creosoting and of the earlier operators in that process, who used in preference the heavier types of creosote; and the early success of that creosote, both in England and tropical countries, appeared to confirm their judgment. A number of experiments were then alluded to, stretching over a long series of years, and conducted by investigators in this and in other countries, for the purpose of ascertaining which of the component portions of the creosote oils were the most durable and efficient agents in preserving timber. The results of these experiments appeared to show that it was not to the tar-acids, but to the heavier and least volatile portions of the creosote, and to those bodies which solidified within the pores of the timber, that the most durable results should be attributed. This apparent anomaly was explained by reference to numerous eminent authorities upon carbolic acid, who, whilst extolling its action as a most useful and powerful antiseptic for sanitary and surgical purposes, were in general agreement as to its possessing the following characteristics:

That it was exceedingly volatile at ordinary temperatures, that it was readily soluble in water, and that its combinations with other bodies, including albumen were not stable. It would therefore readily evaporate from timber exposed to the heat of the sun, especially in warm climates, and it would be washed out of timber in contact with water. The author's personal experience and experiments fully bore out the conclusion that the use of the heavier and least volatile portions of the creosote oils should be encouraged, and that from them the most durable results might be expected. Moreover, it was pointed out that

recent investigators had discovered in these heavier oils bodies which, if perhaps less potent, were more durable in their antiseptic effects than carbolic acid. By judicious selection and admixture both London and country oils could be usefully employed. Shale-oil and bone-oil, however, and other oils lighter than water, should be excluded.

The modern-germ theory was discussed in its relation to timber-preserving, and was believed by the author to be a more practical explanation of the action of antiseptics upon wood than the older theories, as to the coagulation of albumen and the formation of insoluble compounds. With respect to all bodies which had been extensively used for timber-preserving, their durable results appeared to be in an inverse ratio to their volatility in the atmosphere and their solubility in water. The germ-theory constituted a severe but salutary test in choosing antiseptics for the treatment of wood. In the author's opinion the substances preferred should be not only germicides but germ-excluders; those being the best which were least soluble in water, least volatile in air, and most capable of becoming solid within the pores of the timber.

A description followed of the various kinds of apparatus which had been in use during the present century for injecting timber with antiseptic liquids. The paper concluded with some remarks upon the subject and of the hygrometric condition of timber at the time of injection, failures having repeatedly arisen owing to the timber being too wet at the time of creosoting. The author dwelt upon the importance of this subject, describing also his experience with various methods of getting rid of superfluous moisture artificially, and of a process which he had recently inaugurated, by which this result could be obtained in the creosoting-cylinder itself, without injury to the timber.

The paper was illustrated by diagrams showing the most important products derived from coal, and the apparatus for coal-tar distillation and timber-preserving; also by tables, giving the properities of coal-tar products and other substances, of timber-preserving specifications, and of more than 100 references to various authorities upon the topics alluded to in the paper.

At the ordinary meeting on Tuesday of the Institution of Civil Engineers, the 20th of May, Sir J. W. Bazalgette. C.B., President, in the chair, a paper was read "On the Passage of Upland Water through a Tidal Estuary," by Mr. K. W. Peregrine Birch, M. Inst. C.E.

In this paper a description was given of a method laid before the "Royal Commission on Metropolitan Sewage Discharge" by the author, to ascertain the rate of progress out to sea of the sewage discharged at Crossness and at Barking. It was now known that this problem could not be dealt with satisfactorily by means of float experiments; and the author submitted that its only true solution lay in the accurate measurement and localization of the sea water and fresh water contained in the river, considered together with the records of the upland flow contributing to the latter. If it were not for the incoming of sea water, the time occupied by the sewage-polluted Thames water at Barking in travelling to any lower point, say Gravesend, would be exactly the same as the time required by the Thames, with its tributaries and sewage, to fill the channel between Barking and that point. But the salt water occupied part of the channel, and by diminishing the space available for the fresh water reduced the time required for the fresh water to fill that space and pass through it. The author showed that by a complete set of salt tests, made at regular distances apart in the length of the river, and at fixed tidal periods, it could be ascertained with great nicety to what extent any section of the river was occupied by sea water, and consequently what space was left for sewage-polluted river water. The time occupied by the journey of the upland water would be the time required to fill the latter space. It was shown that in dry weather such as prevailed in September, 1882, the sewage discharged at Barking would reach Southend in 32 or 33 days, and in a time of heavy flood, as in November, 1882, in 12 days. The general effect of the calculations was to indicate that, owing to the greater specific gravity of sea water and its tendency to diffusion, the exchange of river water and sea water took place very quickly—much more so than was commonly supposed—so that the upland water passed even more rapidly through the estuary at Southend than at Barking, where the cross-sectional area was not one-twelfth the size.

News from Panama.

PANAMA, May 24.—The city of Aspinwall is in a state of filth that is perfectly indescribable. It is overcrowded. There are no sanitary precautions taken, and the police management is of the poorest. Its streets are oceans of mud. To-day it has a population of fully 12,000 souls. There is a large and very dangerous element in the Isthmus, one that may yet cause trouble, and that will lead to the interposition of foreign powers to protect the rights of their subjects.

The Canal Company have discharged nearly 1,000 men at Aspinwall during the past fortnight. The wet season has arrived. What the company will do with the 10,000 men on its pay rolls is a problem.

During the recent rains the Chagres River rose a few feet and filled in a long canal cut near Colon. In a few hours the work of days, costing an immense amount of money, disappeared as if by magic. The dredge had to be dug out.

The Panama Canal.

The works of the Panama Canal has been divided into fourteen sections, viz., Panama, Paraiso, Culebra, Buena Vasta, Emperador, San Pablo, Bohio, Soldado-Obispo, Matachin, Corozal, Pedro-Meguel, Mamei, Gatun, and Colon. The hardest digging is found on the section between Obispo and Panama. Here is a conglomerate rock, made up of grit, sandstone, clay, etc. It is now under consideration by the company's engineers to dig in certain places, where no excavating has yet been done, to the depth of ten yards, then ascertain the bottom, and afterwards make a new contract for deepening the cut. Official figures recently prepared show the amount of freight transported across the isthmus by the Panama Railroad in 1883 to have been 222,000 tons, of which 92,000 tons were carried for Interoceanic Canal Company.

TAMPING WITH PLASTER OF PARIS.—Plaster of paris makes a very efficient and safe tamping, its peculiar advantage being the abolition of the tamping bar and the consequent danger of explosions resulting from its use. The plaster is mixed to the proper consistency with a little clean, dry sand and poured into the hole. With proper attention the tamping will set in a few minutes, and little more time is required than for tamping in the usual way. It is also found that in many cases the placing of an elastic cushion of some compressible substance just above the cartridge produces good effects. All danger of cutting the fuse in tamping is also removed entirely by the use of plaster of paris.

MARLIN, TEX., May 28.—A levy of 15 cents on the $100 valuation of property was made to-day for road and bridge purposes. Over $20,000 worth of bridges will have to be built in the country to replace those washed away by the recent rains.

SELECTED MISCELLANY.

THE distance from Bismarck to Fort Benton, according to the measurements of the boat survey, as shown in Capt. Quinn's report, is 816.25 miles.

DAKOTA has 1,400 square miles of water surface and 147,700 square miles of land surface. Of the water surface 710 square miles are lakes and ponds and 610 square miles are rivers and small streams.

THE largest county in the United States is CUSTER county, Mont. It covers 36,000 square miles, an area larger than the States of New Hampshire, Vermont, Massachusetts, Connecticut, Delaware and Rhode Island all combined.

THE following statistics regarding Mexico are approximately correct and are given in this form for easy reference. The population of the city of Mexico is 1,000,000; and there are 146 cities, 372 towns, 4496 villages, 5 missions, 5689 haciendas and 14,605 ranches, besides 2213 collections of group of houses denominated congregations, barrios, rancherias, etc. Value of private real estate: Rural—$773,000,000; private real estate in cities, $2,568,036,000; cattle of all kinds belonging to individuals, $123,000,000; property belonging to the nation, $240,000,000; total real estate, not including mines, coasts, bays, lakes, rivers, etc., $3,549,060,000; agricultural products, $117,451,086; industrial products, $14,000,000.

A MILITARY writer in the Paris *Soir* points out the advantage to be gained by France, both strategically and commercially if the Great St. Bernard were tunnelled through, so that Calais might be united in a direct line with Brindisi. At present, the writer states, the St. Gothard Tunnel has been productive of great damage to the existing French line, and he calls on his countrymen not to stand passively by while the trade of England and Belgium, the Indian mails and the industry and commerce of the northern departments of France all find their way over the German line. He proposes that either the Great St. Bernard, the Simplon or Mont Blanc should be pierced, the first, however, being the one through which a tunnel might be most advantageously made from a strategic point of view.

THE Welbeck Tunnel, which the late Duke of Portland, the "Invisible Prince," created for his workmen to pass through on coming to and returning from work, without disturbing the serene repose he longed for, is one of the wonders of the world. During the day it is lighted by enormous plate glass bull's-eyes, superseded at night by hundreds of gas jets. The floor is excellently asphalted, and the tunnel is high enough and wide enough for carriages to pass along. Stepping into it during the hot days of summer, one feels as if he had walked into an ice house, and the whole length of its interior can be traversed without catching the slightest glimpse of the abbey, or the beautiful park under which it passes.

Woods and Forests (English) says: "Any person, however ill informed, might easily get at the exact height of a tree when the sun shines, or during bright moonlight, by marking two lines on the ground, three feet apart, and then placing in the ground on the line nearest to the sun a stick that shall stand exactly three feet out of the soil. When the end of the shadow of the stick exactly touches the furthest line, then also the shadow of the tree will be exactly in length the same measurement as its height. Of course in such a case, the sun will be at an exact angle of 45°. Measurements of this character could be best effected in the summer, when the sun is powerful, has reached to a good height in the heavens, and when the trees are clothed with living green so as to cast a dense shadow. To many to whom this idea may not have occurred, it might be made annually a matter of interest thus on warm summer days to take the height of prominent trees, and so to compare growth from year to year."

THE operations at Peterborough Cathedral, England, prove that a fraudulent builder is no new thing. The walls of the tower, while possessing a specious face of good stone blocks, had within nothing more substantial than loose bits of stone and dry rubbish. The supporting piers below, also, which ought to have been as solid as the rock itself, were found precisely similar in construction, down even to the foundations, where, to the increased amazement of the explorers, a still more flagrant specimen of mediæval "jerry" work was encountered. Correctly speaking, there never had been any foundations to these piers at all, their lower courses having been simply bedded on a layer of loose rubble chips and sand, these in their turn resting upon natural gravel only. There is a rock a foot or two lower down, but, strange to say, no advantage was taken of this circumstance, though it must certainly have been within the knowledge of the old builders. These discoveries compelled the condemnation of the two western piers, which at first it had been the design to spare on account of their seeming soundness. The same indications of grossly slovenly work were revealed in the removal of these also, and the foundations were discovered to be equally worthless.

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Make all drafts, cheques and money orders payable to **Engineering News Publishing Co.**

OUR Paris cotemporary the *Revue Générale des Chemins de Fer* has just issued an elaborate and most carefully prepared analytical index of the total contents of that journal from its foundation in July, 1878, to December, 1883.

The index itself forms a quarto volume of 214 pages, and is so arranged that any technical article, official document or new publication noted during the period can be easily found. It is arranged alphabetically, both under the name of the paper and that of the author.

We congratulate the *Revue* on the enterprise which has produced a work so useful to its readers.

As with books, so with periodicals, of their making "there is no end." The latest monthly venture coming to our office is entitled "Descriptive America," and according to the introductory of its publishers, the geography of the States and Territories is the chief purpose of its being.

Colorado, with its mines, railroads and general future, forms the topic for the initial number, and the subject is very well handled both in text and illustration.

The publication is very attractive in appearance, and if the other States and Territories are to be as generously treated as is Colorado, in the present number, we predict success to its promotors.

It is published by S. H. Adams & Son, of New York, and the Editor is L. P. Brockett, M.D.

INFORMATION is wanted, from the titled world in general, and from engineers in particular, as to the hidden meaning of the characters "N.G." used, in connection with a "C.E.," as an annex to the name of a learned and highly respected member of the profession of civil engineering.

We have seen these initials, inscribed with a blue pencil, across the face of MSS., by the night editor; in fact have so utilized them ourselves. And in this connection their meaning is plain, both to the author and the editor: but what does it mean in the case cited?

We have vainly consulted works devoted to interpreting the "handles" men sometimes use with their names; we find a "Noble Grand" and a "Narrow Gauge," but neither seem to apply in this case, however well-fitting the last might be to some engineers we hear of.

We give it up and ask for light.

WE lately made some remarks concerning the salary paid the "City Engineer" of Wyandotte, Kan. A correspondent reminds us that the city councils of Appleton, Wis., can give their Kansas brethren points in economical management, inasmuch as they only pay $3 per day, for time actually employed.

We hardly know which party to blame the most in this matter; the city authorities who are so blind to the interests of the people they misrepresent, or the man who has so low an estimate of the profession to which he nominally belongs as to accept the proffered pay.

Appleton has a population of 12,000; and we contend that no man professionally fitted to attend to the many engineering demands of such a city can be obtained for the sum named, or hired "by the day." This latter policy is a bad one anyhow, for even if an experienced engineer could be secured, at a proper rate of pay, to work by the day, he would lack that knowledge of details, surrounding conditions and interest in the work as a whole, which would best serve the needs of his employers. It is only natural that such should be the case, when his annual income from the city is to be reduced to a minumum by men who have no conception of the real value of his services, or when these services are most needed.

The tax-payer is after all the party most interested in the high professional standard of the city engineer, and it is time that this fact was more generally recognized. Upon the relative fitness or unfitness of this official depends the perfection and the cost of all public works; and the money expended in undoing bad work and correcting the blunders of the "cheap" engineer, will many times offset the alleged saving in salary.

Convention Notes.

The following additional papers are to be read before the American Society of Civil Engineers, at the coming convention at Buffalo:—Formulæ for the Weights of Iron and Steel Railway Bridges, under Standard Specifications, by George H. Pegram. The South Pass Jetties: ten years' practical teaching in River and Harbor Hydraulics, by E. L. Corthell.

Secretary Bogart announced, at the meeting on last Wednesday evening, that very nearly 400 persons had expressed their intention of being present at Buffalo; of this number, about 250 will leave New York by the special train on next Monday morning. As the hotel accommodations of Buffalo are hardly commensurate with the rank and population of that city, some difficulty was experienced in obtaining the requisite quarters for the members; but by the personal exertions of the Secretary, aided by the local committee, this matter has been satisfactorily arranged.

E. L. Corthell, Chief Engineer of the N. Y., West Shore & Buffalo R. R., has issued a circular to members of the Society, giving the time and place of starting, as at the foot of W. 23rd St., New York, on next Monday morning at 8 o'clock, sharp. All arrangements have been made at this point for the checking of baggage.

The train leaves at 8:30, allowing about ten minutes to examine the passenger station. By this same circular, each member is notified of the car he is expected to occupy in the train.

This special train will stop five minutes at Chain Dock Bridge, Rondout Viaduct, Cook's Fill, and Diefendorf Hill wall; also ten minutes for lunch at Kingston, and thirty-five minutes for dinner at Syracuse, and at other points designated in the special time-table prepared.

The excursions arranged for the members in Buffalo, include an inspection of the Tift Farm Improvements, with the grain elevator and coal shutes at that point; the Buffalo Trunk Sewer; an excursion by steamer down the Niagara River, and a trip to the Suspension and Cantilever Bridges at Niagara Falls, including a dinner at the Cataract House. Additional excursions will probably be announced at the place of meeting in Buffalo.

The Panama Canal.

According to the *Bulletin du Canal Interocéanique*, of May 15, 1884, the work done in April amounted to 866,000 cu. yds.; an increase of 46,600 cu. yds. over the work in March. The total work done to May 1, 1884, equals 7,085,568 cu. yds.

The Corinth Canal.

From *Le Canal de Corinthe*, of May 15, 1884, we find that the work done for the month of April last amounted to 106,400 cu. yds., this being the largest amount yet taken out in any one month.

A drilling plant has been set up, on the Isthmia side, for drilling the long vertical holes intended for the removal of the "main cut." The drills having met moving sand, it has been found necessary to tube the holes. Sheet-iron cartridge cases have been employed with good results. The attempt to use fuse protected by gutta-percha, has proved a failure, and electric fuses have been definitely adopted, A diamond-drill, of the *Taverdon* type, is being used by the company.

The two 300 H. P. dredges, built at Lyons, are now at the Isthmus, and are being mounted for service; the machinery was sent by steamer, and the hulls towed to Kalamaki. The first dredge is expected to be at work in July next, and the other in August.

Engineering Colleges.

RENFREW, ONT., MAY. 27, 1884.

EDITOR ENGINEERING NEWS:—Wishing to take a college course in civil engineering, would you inform me through your columns which you consider the best among American Colleges for Engineering, and oblige

Respectfully, SUBSCRIBER.

[We cannot designate the "best" American College of Engineering. By reason of age, its complete equipment, and the high success of many of its graduates, the Rensselaer Polytechnic Institute at Troy, N. Y., is, we believe, accorded first place among American engineering schools. It is devoted exclusively to civil engineering, and is not, like all the other engineering schools, affiliated with collegiate institutions. It has a large staff of teachers, and is well supplied with apparatus and accessories necessary for a complete course in civil engineering; its standard is high, and it takes four years of hard labor to graduate with any considerable degree of honor. The expense is greater than at any other school in the country.

Practically, there are several "schools" of engineering in the country from which a young man may graduate with as good chances for future success as he can from the Troy Institute. It depends very greatly on the personal ability and application of the student. We do not know what there is in Toronto, but to our Canadian correspondent we can recommend the engineering class of McGill College, Montreal. It was not entitled to the name of an engineering class away back in 1858, when we attended it, and but for its excellent mathematical course under the then and

present Prof. Alex. Johnson, it would have been a dismal failure; under Prof. Bovey it has attained to a considerable degree of excellence, and if a student works hard, he can acquire a first-rate engineering course of instruction in McGill University. The expenses of living in Montreal are very light, comparatively; $250 to $300 for eight months will cover everything.

At Ann Arbor, Mich.; Hanover, N. H.; New Haven, Conn.; Bethlehem, Pa.; New York City; Philadelphia, Pa., and Cambridge, Mass., are engineering schools, which are practically as good as the one at Troy. Already the graduates from these are filling important positions, and with the benefits of age and prestige, such as are now only had by the Rensselaer Institute, they will be entitled to equal rank with the latter.

There is also a scientific course given at the Chandler Institute, in connection with Dartmouth College, Hanover, N. H., which we especially recommend. It is largely for engineers, but not entirely so, and a degree of Bachelor of Science is given. It is intended to give young men as practical an education as can be devised, and fits them for entering upon the serious duties of life with their faculties of observation very thoroughly trained. The cost of living at Hanover is about the same as in Montreal, and it is a desirable place for a student, who is in earnest to secure an education at the lowest expenditure of money.—ED. ENG. NEWS.]

American Society of Mechanical Engineers.

The opening session of the Society of Mechanical Engineers was held in Pittsburg, May 20th, in the rooms of the Pittsburg Y. M. C. A., being a joint meeting with the Engineers Society of Western Penn. Mr. Wm. Miller, of the latter society, made the address of welcome, and Mr. John E. Sweet, of Syracuse, N. Y., responded.

Mr. A. E. Hunt then read a report on "Natural Gas for Industrial Purposes," which was interesting and lengthy enough to consume the time of the first meeting.

The Wednesday morning session was held at 10 o'clock in the rooms of the Western Iron Association, and was devoted to the transaction of routine business, and to the reading of a communication from Prof. Thos. Egleston, Chairman of the Committee of the American Institute of Mining Engineers, on Standard Forms for Test Pieces, soliciting information on this subject.

The first paper read was by John W. Cloud, of Altoona, Pa., on "Helical Springs;" this was followed by a paper from Prof. Wm. A. Rogers, of Cambridge, Mass., on "A Practical Solution of the Perfect Screw Problem." Both papers were discussed at length by the members present.

At the evening session a paper was presented by Mr. Wm. Kent, on "Rules for conducting Boiler Tests." The paper was discussed by Mr. Chas. E. Emery, among others. "From New York to Chicago in Seventeen Hours," was then read by Mr. Barnet Le Van; this was followed by "Estimates for Steam Users," by Mr. Chas. E. Emery, of the New York Steam Co. Mr. H. R. Towne, of Stamford, Conn., read a paper upon "A Drawing Room System," and Mr. Oberlin Smith one upon "A Positive Speed Indicator."

Thursday was devoted to excursions to points in interest of the Allegheny Valley, the Isabella Blast-furnaces, at Etna, were visited, also the Ford Plate Glass Works, the Soda Works of the Penna. Salt Co., at Natrona, the Pittsburg Water-works at Brilliant Station, the Keystone Bridge Works, the Cresent Steel Works, Messrs. H. K. Porter & Co's Locomotive Works, and finally the works of Messrs. Park, Brother & Co. In the evening banquet was held at the Monongahela Hou

On Friday visits were made to the Iron-works of Jones & Laughlins, the Edgar Thomson Steel Works, the Duquesne Forge, and the Pittsburg Steel Works. The attempt to hold a session upon the steamer for the reading of a paper by Mr. Geo. H. Barnes, on "Comparison of Three Types of Modern Indicators," was somewhat of a failure, owing to the noise and surrounding conditions. The meeting was terminated on the landing of the party at Pittsburg.

The Philadelphia Electrical Exhibition.

This exhibition will open September 2, and close Oct. 11th. The committee of the Franklin Institute, who have the matter in charge, are busily engaged in perfecting plans, and there is abundance evidence that the exhibition will be of unusual interest and value.

The location selected is an open space adjoining the old passenger depot of the Pennsylvania Railroad Company at Thirty-second and Market Streets, and the demand for space is so great, that an effort is being made to secure the depot itself. The main exhibition building is 283 × 160 ft. with towers 50 ft. high at each corner. There are 67,000 sq. ft. of space on the ground floor, and half as much more in the galleries and other parts of the building.

The Edison, United States and Brush Electric Light Companies have secured space for exhibits. Among the most interesting exhibits will be the application of electricity in the running of railroad trains, printing presses, sewing machines, underground cable systems and signaling apparatus, and in playing pipe organs. Illustrations of storage batteries for light and power will also be given. Interesting contributions are expected from the Light house Board, Signal Service and Ordnance Departments of the United States. Through the State Department at Washington application has been made to all foreign governments for the loan of historical apparatus of interest in the development of electrical science; and, to supplement these, many of the leading colleges of the United States are expected to exhibit similar apparatus.

Another feature will be an extensive bibliographical display. Every publisher in the United States and Europe will, it is said, be asked to contribute copies of work relating to electricity. To scientific men and authors a similar appeal will be made. Visitors to the exhibition will have access to these volumes, and at the close they will be added to the Franklin Institute Library.

The Industrial Situation.

The future of the iron trade is at present befogged with considerable uncertainty. Well-located mills, with regard to supplies and markets, will feel no particular pinching, no matter how low prices may go, or no matter how dull trade generally may become. There is, however, a large percentage of mills and furnaces that will feel the pinchings of competition and dull trade seriously, to such an extent that it will continue to be a question with them, for perhaps a year or two to come, whether to run or to suspend. A good many concerns are making money, yet perhaps one-half of the iron that is turned out is sold at a very slight profit, enough, however, to induce the makers to continue, in hopes of better days, rather than to desert the market, and leave it to others. A great deal of production is now going on in the hopes that someone else will be frightened or worried out. There is a considerable degree of interest manifested in new fields in consequence of this condition of things. A number of engineers and chemists connected with the iron trade have had the question referred to them, within a few months, of determining the advantages of new locations for mills and furnaces, especially in the South. The facilities and advantages of southern iron and coal fields have been the subject of very close inquiry on the part of a good many manufacturers. The cost of iron-making, in the South, has been pretty well gone over by furnace men, mill men, experts and newspaper correspondents. One factor is wanting to give the proposed departure in iron-making a start, and that is the very important factor of a sufficient local demand in these new sections. While iron can be made cheaper in Alabama than in the North, it is not cheaper when it is put into the market north of the Ohio or the Potomac. Herein is the trouble. If the South could furnish a good local demand, there is nothing in the way of a rapid development of iron making in the Birmingham and Sheffield regions. Southern cotton manufacturers are running against the same difficulty. Even with all their vaunted advantages, they are shutting down, restricting output, reducing salaries and wages, and trimming their sails for the coming storm. The New England plaid manufacturers are doing the same thing. What the South wants is a much greater local demand than it is likely to receive for some time to come. The protection our northern industries have is just here. While this question is not settled, it is evident that the northern textile and iron establishments will be able to hold their own in the struggle for existence. It must be admitted that the southern people have more room to turn around in; more economies to put into practice; a wider field to fill as population and demand increase. The cost of production in the New England and Middle States has reached a limit where the only remedy is restriction. The cost of production in the Southern States has not yet reached that limit. How soon it will, is a question of interest both to them and to us. Cheaper labor there is but a small factor. Experience demonstrates that high-priced labor is in the end the cheapest. There are, however, a number of advantages to be derived in southern locations, which continue to attract a good deal of capital, and invite enterprise and stimulate a spirit of inquiry. The investment of half a million dollars of a foreign manufacturing firm, in Tennessee and Alaboma, is a straw which shows which way the wind is blowing. Those who make their investments in view of the future southern local demand will make no mistake. Those who invest in view of their present ability to compete with northern manufacturers will make a very grave mistake.

Within three years the number of furnaces out of blast has increased from 255 to 400. The price of foundry iron has declined from $25 to $20 per ton. The production of pig iron of all kinds has increased from 3,800,000 tons to 4,600,000 tons. Stocks to-day are very little different from what they were three or four years ago. Within one year the increase has been 100,000 tons in round numbers. It is not likely that the increase for 1884 will show the same ratio. Blast furnace men are following a conservative policy and carrying only sufficient stocks to provide for the probable requirements of the immediate future. Forge iron has sold as low as $16.50 at tidewater, although all the better grades are held somewhat more firmly. Refined iron is selling in some cases as low as 1½ c., under sharp competition. Plate iron has sold within a week as low as 2 c. Steel rail contracts have been heard of within a few days below $22 for winter delivery. Rail brokers intimate that large contracts are likely to be closed during the summer at this extremely low figure. Engineering requirements do not grow apace. From privat sources we learn that nothing more than a hand to mouth demand exists in any and all of the markets from Boston to St. Louis. Most of the heavy requirements spoken of early in the spring have been filled. Purchasing agents have the liberty to contract for additional large supplies or not, as they wish. The

managers of the leading trunk lines are not contemplating any further extensive improvements. The principal work now in hand is the completion of improvements mapped out a year ago. The iron trade is as rapidly as possible putting itself into shape for a lessening demand. This, however, should not deceive us. The legitimate requirements of the country are enormous. The much talked of uncertainties of a presidential year have, perhaps, somewhat to do with the backwardness of demand. It is within the range of possibility for a sharp improvement to develop itself before the close of the summer. Very much depends upon the course and volume of railway traffic, and upon the adjustment of the values of railway securities with real values. The financial failures, and the possibilities of further general depreciation of railway stocks, are acting as a barrier to the furtherance of a good many contemplated enterprises. It is altogether improbable that lower prices will be named than those now quoted. In construction iron and railway material there is room for little closer competition. This competition may be looked for unless a general improvement should come to the rescue of the now partially employed industries. The trade combinations in the interest of steady prices are measureably successful, but after all the great under-lying law of competition will upset the calculations of those who would artificially restrict production in hopes of better prices.

The coal producers in every part of the country are fighting against influences which are too much for them. With all that has been done to restrict, the shading of prices is general in all markets. The anthracite producers are obliged to extend their policy of restriction to limits which seriously interfere with their earning powers. Bituminous coal is supplanting anthracite to a considerable extent in the eastern markets. A great deal of territory has been developed, and the competition of the two coals will become very interesting to consumers from this time out.

New England Water-works Association.

The Third Annual Meeting of the above named organization will be held at Lowell, Mass., on Thursday and Friday, June 19th and 20th.

The headquarters of the society during the convention, will be at the St. Charles Hotel, on Middlesex street in that city, at which place members are requested to assemble on Thursday, June 19th, at 10 o'clock, a. m.

The attention of all those eligible is respectfully called to the objects of this association, whose work can be largely extended, should a representation be present from each city and town in New England having a water supply.

Members of water boards are cordially invited to be present at any meeting of this association.

That ample provision may be made for the comfort of all, those expecting to attend are requested to promptly notify Horace G. Holded, Esq., Supt. Water-works, Lowell, Mass.

PROGRAMME:—*Thursday, June* 19.—10 A. M., Business Meeting, Annual Reports, Election of Officers for ensuing year, etc. 3 P. M.—Discussion of the following named topics: 1st. Service Pipes, material, size, etc. Opened by a paper to be presented by W. H. Richards, C. E., of New London Conn. 2d. Filtration of Water. Opened by a paper to be presented H. W. Rogers, Esq., of Lawrence, Mass., General Discussion, at 7½ P. M.

Friday, June 20.—The City Government and Water Board of Lowell hereby extend an invitation to visit the different points of interest connected with the Water Works of that city, after which the party will participate in an excursion on the Merrimac River to Tyng's Island, returning by 5 P. M., in time to connect with the late afternoon trains.

PERSONAL.

MR. HENRY VILLARD, late of Northern Pacific fame, has been engaged by WHITELAW REID, of New York *Tribune*, to run the railway column of that paper. The salary has been fixed at $30 per week.—Cleveland *Leader*.

S. B. WHITING, general manager of the Philadelphia and Reading Coal and Iron Company, was recently elected a member of the Chesterfield and Derbyshire (Eng.) Institute of Mining, Civil and Mechanical Engineers.

MESSRS. GUY H. ELMORE and GEORGE R. BAUCUS, late assistant professors at the Rensselaer Polytechnic Institute at Troy, have purchased rights under the Durham patents for Kansas and Western Missouri, and will organize the Durham House Drainage Company of Kansas City.

MR. W. W. BIDDULPH, a well known English Electrical Engineer, having been previously connected with the laying of the first Atlantic Cable, arrived in this city by the steamer Republic on the 24th. MR. BIDDULPH reports the electrical "situation" in England as in a most unsatisfactory condition, the business having run to stock-jobbing and being overdone. MR. BIDDULPH was a visitor at the meeting of the American Society of Civil Engineers on Wednesday evening.

ALFRED WILLSON, Chief Engineer of the Canada Land Company, the oldest and wealthiest real estate corporation in Ontario, with headquarters in Toronto, is enjoying a vacation of a couple of weeks in New York city and vicinity, and was a guest at the meeting of the American Society of Civil Engineers on Wednesday evening. In reclaiming large tracts of land from overflow, MR. WILLSON has conducted some of the most extensive drainage operations of which there is any record in this country.

CHARLES G. DARRACH, for seven years Principal Assistant Engineer of the Phila. Water Department, has severed his connection with the city service, and has connected himself with the well known firm of Wilson Bros. of Philadelphia and Chicago. MR. DARRACH will take charge of all duties pertaining to water-works construction.

The Water committee, of the City Councils, passed a resolution of regret upon the retirement of MR. DARRACH, expressing their appreciation of his long service, which they say was creditable to himself and profitable to the city, and extending to him their good wishes for the future.

OBITUARY.

GEN. MANSFIELD LOVELL, formerly of the United States Army, and afterwards an officer in the Confederate forces, died at his residence in New York, on June 1, 1884. GEN. LOVELL was born in 1820, in Washington, D. C., and was the son of Surg. Gen. Joseph Lovell. He graduated from West Point on July 1, 1842, as Second Lieut. of Artillery, and served with the 4th Artillery in the Mexican War, and resigned in 1854 from the army.

In 1858–1861, he was Superintendent of Street Improvements and Deputy Street Commissioner of New York. He entered the Confederate service in 1861, and served throughout the Civil War. He was lately Assistant Engineer to Gen. Newton on the works on the Raritan River.

SAMUEL M. SHOEMAKER, ex-vice president of the Adams Express Co., and one of the pioneers in the express business in this country, died at Old Point Comfort, Va., on May 31. MR. SHOEMAKER was born in Pennsylvania, and in 1843, when only 22 years of age, joined E. S. Sanford, of Philadelphia, in organizing an express line between Philadelphia and Baltimore. He was one of the originators of the Great Western Express Co. between Baltimore and St. Louis, and from that time forward was associated with Alvin Adams and the Adams Express Co., formed in 1854 from a consolidation of competing lines.

GEN. ORVILLE E. BABCOCK, was drowned on June 3d, while attempting to cross Musquito Inlet Bar, Fla., in a small boat during a high wind.

Gen. Babcock was born in Vermont, and was about 44 years of age. He graduated from West Point in May, 1861, and was at once assigned to duty, as Brevet Second-Lieutenant, U. S. Corps of Engineers, at Washington. He served throughout the war, and was commissioned Major of Engineers, March 21, 1867.

He was private Secretary to President U. S. Grant until March 4, 1876; and also served as Commissioner of Public Buildings, was Superintending Engineer of the Washington Aqueduct, of the Chain Bridge and of the east wing of the building, for the State, War and Navy Departments.

On March 12, 1877, he was appointed Light-house Inspector of the Fifth District, and held that position at the time of his death.

BREVET MAJOR GEN. HENRY W. BENHAM, formerly of the Engineer Corps, U. S. Army, died in New York on June 1. GEN. BENHAM was born in Connecticut, entered West Point July 1, 1833, and graduated July 1, 1837 as Second Lieut. in the Corps of Engineers. In that rank he served as assistant engineer in the work of improvement on the Savannah River during the years 1837 and 1838. On July 7, 1887, he was promoted to the grade of First Lieut. in the Engineer Corps, and from 1839 till 1844 he served as superintending engineer of the repairs of Fort Marion and of the sea-wall at St. Augustine, Fla. In 1844 and 1845 he was engaged on the repairs of the defenses of Annapolis Harbor, and in 1845 returned to the work on the sea-wall at St. Augustine, where he remained until 1846. During a part of 1845, however, he was engaged on repairs at Fort Mifflin, Penn., and at Fort McHenry, Maryland, and during parts of 1846 and 1847 he worked on the repairs of Forts Madison, Washington and Maryland. In 1847 and 1848 he fought in the war with Mexico. He was engaged in the battle of Buena Vista, Feb. 22 and 23, 1847, and on Feb. 23 was brevetted captain for gallant and meritorious services in that battle. In 1848 and 1849 he was engaged as assistant engineer in the repairs of the defenses in the harbor of this city, and on May 24, 1848, was promoted to the rank of Captain in the Engineer corps. From 1849 to 1852 he acted as superintending engineer of the construction of the sea-wall for the protection of Great Brewster Island, Boston Harbor. In 1852 he superintended the building of the Buffalo light-house, and in part of the same year and part of 1853 superintended the construction of the navy-yard of Washington.

In 1853 Capt. Benham was assistant in charge of the United States Coast Survey office at Washington, and was in Europe on duty connected therewith from March 29 to Nov. 1. He was promoted to the rank of Major in the Ninth Infantry March 3, 1855, but declined. In 1856 and 1857 he was superintending engineer of the building of Forts Winthrop and Independence, Boston Harbor. In 1858 he superintended the survey of the site for a fort at Clark's Point, New-Bedford, and the repairs of Fort Adams, Newport, R. I., in 1857 and 1858. He had charge of the building of the fort at Sandy Hook, N. J., from 1858 to 1861, and of the Potomac Aqueduct in 1860. He was a member of the special board of engineers for modifying the Sandy Hook fort in 1860, and was engineer of the Quarantine Commissioners of this port in 1859 and 1860. He served in the war of the rebellion from 18

to 1866. He was on the staff of Brig.-Gen. T. A. Morris as Engineer of the Department of the Ohio, and was present at Laurel Hill, July 11, 1861. He was brevetted Colonel for gallant conduct at the battle of Carrick's Ford, Virginia, July 13, 1861, and was in command of the engaged troops on that day. On Aug. 6, 1861, he became a Major in the Corps of Engineers, and on Aug. 13 was made a Brig.-Gen. in the volunteers. He commanded his brigade at New Creek Aug. 16, 1861, and was engaged in the action at Carnifex Ferry Sept. 10, and the pursuit of the rebel forces from Cotton Hill to Raleigh County, Va., Nov. 12 to 16.

In 1862 he was successively engaged as superintending engineer of the fortifications in Boston Harbor and as commander of the Northern District of the Department of the South, being present at Tybee Island, Georgia, during the bombardment and capture of Ford Pulaski, and at the attack on Secessionville, James Island, S. C. He was superintendent of the construction of the fortifications of Portsmouth Harbor from Sept. 8, 1862, to Feb. 28, 1863, and was in command of the engineer brigade of the Army of the Potomac from April 29th to May 5, 1863, engaged in superintending the throwing of pontoon bridges across the Rappahannock for the passage and retreat of the army at Chancellorsville. During this time he was made Lieutenant-Colonel of the Corps of Engineers. He was engaged in building pontoons at Franklin's Crossing in the face of the enemy, June 5, 1863, on the Potomac at Edward's Ferry June 21st, was in command of the pontoon depot at Washington from July, 1863, to May, 1864, and was in command of the engineer brigade from June, 1864, to June 15, 1865, being engaged in superintending the laying of a pontoon bridge 2,200 feet long across the James River at Fort Powhatan, June 15, 1864. He constructed and commanded the defenses at City Point, Va., in October, 1864, and on March 13, 1865, was brevetted Brigadier-General for gallant services in the campaign terminating with the surrender of Lee. On the same date he was promoted to the rank of Major-General of the United States Army. He was mustered out of the volunteer service on Jan. 15, 1866.

On March 7, 1867, he was made a Colonel in the Corps of Engineers, and was engaged on works at Plymouth, Salem, Marblehead, Gloucester, and Boston. From Oct. 25, 1869, till July 30, 1877, he was engaged on works on Long Island Head. Subsequent to 1877 he was for some years in charge of Fort Mongomery, this harbor, and also the defenses of the harbor, except at the eastern entrance and on Staten Island. In Oct. 1877, he became a member of the board for the examination of engineers for promotion. His retirement took place June 30, 1882.

CORRESPONDENCE.

Special Correspondence Engineering News.

HAVERHILL, MASS., June 2, 1884.

EDITOR ENGINEERING NEWS:—In your last issue, Mr. Franklin states that a curve of 226.18 ft. radius is a 25° 19′ curve and not 25° 32′; also that a curve of 417.17 ft. radius is a 13° 44′ curve and not 13° 46′, as stated in my communication on the subject of race courses. If he will use 100 ft. *chords* in laying out his curves, and not 100 ft. *arcs*, he will find that my angles are correct. The radii and degrees of curvature, as given in Henck's Book are all computed with 100 ft. *chords*.

Yours, etc.,

JOHN T. DESMOND.

The total length of the street railways, or tramways, in England, Scotland and Ireland, is 669⅞ miles, according to the last official report, of June 30, 1883. The total cost of construction was $48,750,000, including the rolling stock and equipment of all kinds. The 141 lines are worked with 20.122 horses, 117 locomotives and 2.819 cars.

LITERATURE.

The Thirtieth Annual Report of the Board of Water Commissioners of the City of Hartford, Conn., for the year ending March 1, 1884.

Water rents received for the year, $138,902.75; interest paid on outstanding Water Bonds $55,911,67, repairs and distribution, $10,758.18; current expenses $19,230.31. Total expenditures $85,900.16.

The Commissioners report this city as exceptionally well provided with water, their four reservoirs storing a maximum of about 1,177,000,000 gallons, at elevations ranging from 260 to 400 ft. above the Connecticut River.

City of Toronto (Canada), Reports of the City Engineer, including the Works performed and Expenditure for the same in 1883.

The total Expenditure for the year was $756,876.00, of this amount the following appropriations were for Local Improvements:

Pavements	$474,544.56
Sewers	155,814.59
Sidewalks	1,736.00
Grading and Bridging	7,356.00
Total	$639,451.15

Cedar-block pavements, to the amount of 12¾ miles, were laid down in the year, and 23½ miles of side-walks, 2 $\frac{62}{100}$ miles of sewers were constructed.

Examinations are now being made for the disposal of sewage, and plans will soon to be presented for the system contemplated.

Annual Report of the Trustees of the Water-works of the City of Cleveland, 1883.

The receipts for the year amounted to $274,614.15, and the expenses and repairs to $73,210.82; the increase in receipts over 1882 is, $22,619.69.

John Whitelaw, Engineer and Superintendent, reports the increase in the distribution system as being 21 miles 832 ft., and in main-pipe 1 mile 4,497 ft.; the total pipe system now amounts to 175 miles, 4,951 ft., of which 15 miles, 2,236 ft. is main pipe. The total number of hydrants is 1501, and the number of meters 849.

The daily average consumption of water for 1883, was 14,212,144 gallons; the rate of increase for the year was 15.41 per cent. The cost of pumping each million gallons, 100 ft. high was $4.56.

The contract for the new Fairmont Reservoir was let in June, 1883, to Messrs. McReynolds & Gawe, for the sum of $269,184.50. Work to the amount of $53.327 has been done.

The contract for the High Service Reservoir was awarded in October, 1883, to Messr. Freeman & Hall, for $120,814. Only $12.684 of work has been done.

Report of the Joint Committee Appointed by the States of Pennsylvania and Ohio to ascertain and re-mark the Boundary Line between said States as it was originally established.

We are indebted to James Mackey, one of the Ohio Commissioners, for a copy of the above report, including topographical maps of the line from Lake Erie to the Ohio River.

The report commences with a detailed history of the boundary lines, from that established by the joint commissioners of Virginia and Pennsylvania in 1779, to Andrew Ellicot's line of 1786. It is the latter line that was resurveyed by the late Commission. This work was attended with considerable difficulty, only nineteen of the original monuments being found, and of these only two gave satisfactory evidence of occupying their original position.

The extreme points being finally fixed, the entire line has now been re-run and permanently marked with two stones, one a cube of sandstone, 15 in. square, called the "monument," appropriately marked, and sunk two feet below the surface; and another called the "index," 12 in. square and 3 ft. long placed near the line. The stones, placed at one mile-intervals, were of sandstone, the terminamonuments were of granite, conspicuous in form and permanently planted. The report contains full notes of the survey and the location of each monument.

The Journal of the Franklin Institute for June, 1884.

Contents:—The Cheapest Point of Cut-off, Wm. Dennis Marks; Turbines, De Volson Wood; The Ellipticity of Planets, L. d'Auria; To Chicago in Eighteen Hours, Robt. Grimshaw; Surveys for Future Water Supply, Col. Wm. Ludlow.

Transactions and Proceedings of the American Society of Civil Engineers, for March, 1884.

Contents:—Preliminary Report of the Committee on a Uniform System of Tests of Cements, and discussion. The Railway Pile and Pontoon Bridge across the Mississippi River at Prairie du Chien, by John Lawler; Temperature of Water at Various Depths in Lakes and Oceans, by Hamilton Smith, Jr.

The report on Cement Tests cannot be condensed, and we expect to publish it shortly in full. The paper of Mr. Lawler describes a bridge built in 1874, across two channels, 1,500 and 2,000 ft, wide respectively. The structure is an ordinary pile bridge except at the openings provided for navigation; these openings are each closed by a single float, 30 ft. wide at bottom, 6 ft. deep, and 41 ft. on deck, and 408 ft. long. The height of the track is regulated by a system of blo king confined in a frame and adjusted by means of hydraulic jacks. The range of variation between high and low water is 22 ft.; 600,000 ft. B. M. of timber was used in the construction of each float.

The draw is opened by a steam-engine of 20 H. P., working a chain which lies on the bed of the river, and is secured at points above and below the bridge. The cost was one-sixth that of the estimated cost of an ordinary pivot-bridge at the same point.

The contents of the paper upon the Temperature of Lake and Ocean Water, has already been given in ENGINEERING NEWS of May 24.

Forty-fourth Annual Report of the Water Department of the City of Cincinnati, for the year ending Dec. 13, 1883. A. G. Moore, Superintendent and Engineer.

Mr. Moore reviews the progress made in the department within the last four years. In 1880, the annual revenue was $443,000, and the running expenses $207,000; the ratio of expenses to receipts being 47 per cent. The revenue for 1883 was $553,000, and the running expenses $207,000, making the ratio of expenses to receipts 38$\frac{8}{10}$ per cent.; although the water rates have been twice reduced within the four years, decreasing the receipts for 1883 nearly $50,000.

During the four years, 27.64 miles of water-mains from 3″ to 46″ diameter, have been laid, at a cost of $405,000.

During the flood of February, 1883, all the pumping engines were necessarily stopped on Feb. 11th, but the reservoirs were filled to repletion, storing 120,000,000 gallons of water, and held out until Feb. 17th, when the pumps were again set in motion as the flood receeded. The highest water-mark reached by the flood was 66 ft. 4 in. above low water-mark; this being 25 in. above the flood of 1832, and 33 in. above that of 1847. The injury to the machinery and plant of the department was about $5,000.

In 1883, with a population of 293,000, the daily average consumption of water was 19,401,200 gallons, or 66 gallons per capita. There are now laid 209,33 miles of water-pipe, and 972 metres and 430 hydraulic elevators are in use. The established reservoir capacity is 106,500,000 gallons, and the maximum pumping capacity, in gallons, is 48,000,000.

The department receives 7$\frac{55}{100}$ cents for each 1,000 gallons of water pumped, and pays, including interest, 4$\frac{34}{100}$ cents per 1,000 gallons. The bonded indebtedness of the works is $1,625,000.

In correcting the waste of water, during the year 1883, 5,477 abuses and leaks were checked. Of these, 2,444 were from visible leaks in hydrants and hose plugs, 1,605 from underground leaks in lead pipes, stops and hydrant-stocks, 367 cases of willful waste in hydrants and home fixtures; and the remainder from various courses.

The report contains a handsome map showing the district flooded in February, 1883, and also extracts from the *Cincinnati Commercial Gazette*, giving a consecutive detail of the rise, extent and subsidence of the waters of the Ohio River, and the action of the city and State authorities and the relief committees, together with many interesting incidents of the memorable flood.

Twelfth Annual Report of the Public Water Board of the City of Lynn, (Mass.) for the year ending Dec. 31, 1883.

The Board report a bad condition of affairs as existing in the beginning of the year 1883. The engine house in bad repair; both cylinders of the pumping engine cracked, and the distribution system weak, with frequently bursting pipes.

The receipts for the year from all sources were $190,965, and the expenditures, for maintenance, $21,456.16 and for construction $100,537.69; of this last amount $30,873 was for mains, hydrants and gates, and $48,213.7 for a new supply.

The cylinders of the Leavitt pump having cracked, the Deane Steam Pump Co., was contracted with to furnish a 3,000,000 gall. pump, for $9000, to serve as a reserve. This pump is now in place and has given great satisfaction, both in duty and capacity having exceeded the guarantee of the contractors. The Leavitt Engine is being repaired.

The yield from the tubular wells was 388,191 gals. per 24 hours. Another 6 in. tubular well was put down during the year; which increased the supply to 618,000 gals. in 24 hours, when pumping. This last well is 71 ft. deep, and penetrates 58 ft. of solid clay and 13 ft. of water-bearing gravel. The water rises to within 22 ft. of the surface.

Complaint is made that the cement pipe used in the distribution frequently causes trouble by the rusting of the pipe when drilled for the corporation cocks.

Surveys have been made for a new supply, from the Saugus River and Hawkes and Penny Brooks. On Sept. 4 1883, the Board were ordered to construct a tunnel and canal between Saugus River, at Howlett's Dam, and Birch Pond, and by a 30 in. pipe through the pond to the gate-house at end of Breeds Pond, to the pumping station. The canal is almost finished but the tunnel is not progressing satisfactorily.

The official test of the Deane Pump gave a duty of 62,512,269 foot pounds.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E. : M. INST. C. E.

(*Continued from page 276*)

DCXLV. COLUMBUS, GA.

Columbus, Georgia, in lat. 32° 30′ N., long. 85° W., the county seat of Muscogee County, is on the Chattahoochee River.

It was incorporated a city in 1827.

Water-works were built in 1882 by a private company, taking the supply from the head waters of Holland's Creek in the State of Alabama, the creek being a tributary of the Chattahoochee which, at this point forms the boundary line between the States of Georgia and Alabama. Two masonry dams impound the water from about 20 sq. miles of watershed, forming reservoirs which together cover about 25 acres, and have a combined storage capacity of 120,000,000 gals. The lower reservoir is 115½ ft., and the upper one 130 ft. above the central part of the city, and from them a 12 in. cast-iron conduit four miles long carries the water to the distribution pipes. At the Chattahoochee River the 12in. main is subdivided, and is laid under the bridge in two sections 9 in. in diameter which again unite on the Georgia side in a 12 in. pipe.

Distribution is by 7½ miles of cast-iron pipe of 12 to 4 in. diameter, with 66 fire hydrants, 23 gates, and 425 taps. Wrought-iron is used for services. The city pays $80 yearly for each hydrant. The daily consumption in 1883 was 200,000 gals.

The population in 1880 was 10,123, it is now said to be 20,000.

The capital stock of the company is $150,000, and the cost of the works has been $140,000. B. F. Archer is President of the company, and Jacob H. Yocum, Engineer.

DCXLVI. LEWISBURG, PA.

Lewisburg Pennsylvania, in lat. 40° 57′ N., long. 76° 55′ W., the county seat of Union County is on nearly level ground on the West Branch of the Susquehanna River.

It was settled in 1785, and is the seat of Lewisburg University which was established in 1847. It is now incorporated a borough.

Water-works were built by a private company in 1883, after plans and under the superintendence of S. D. Bates, taking the supply from the river. Just below the town a 4 ft. dam crosses the river giving at low water a depth of 7 ft. over the mouth of the suction pipe which extends 550 ft. into the stream. The water is pumped by a compound duplex, non-condensing Knowles pump of 16 and 10 in. steam, and 10 in. water cylinders and 12 in. stroke, lifting 140 ft. to a stand-pipe 12 ft. in diameter and 130 ft. high. The ordinary pressure is 55 lbs. which in case of fire can be raised by direct pumping to 125 lbs.

Distribution is by 5½ miles of cast-iron pipe of 10 to 4 in. diameter, with 43 fire hydrants, 16 gates and 1 meter and 76 taps. Service pipes are of galvanized and plain iron.

The borough pays $1200 yearly for hydrants. The population in 1880 was 3,080. The daily consumption in 1883 was about 30,000 gals.

The capital stock of the company is $32,000, its bonded debt is $5,000 at 5 per cent. The works have cost $34,947, and have been in operation since Dec. 1, 1883.

Eli Slifer is President, and S. D. Bates, Superintendent.

DCXLVII. RANDOLPH, N.Y.

Randolph, Cattaraugus County, New York is in lat. 42° 10′ N., long. 79° 8′ W.,

Water-works were built in 1883, by and after the plans of J. A. Cloud & Co. as a private enterprise, taking the supply from springs on a large tract of forest on the mountain side 2½ miles from the village. A timber and earthen dam forms a large impounding reservoir, 220 ft. above the village whence the water is conveyed and distributed by 3½ miles of cast-iron pipe of 10 to 4 in. diameter.

The population in 1880 was 1,111, it is now said to be 2,300.

No further information can be obtained.

DCXLVIII. TURNER'S FALLS, MASS.

Turner's Falls, Franklin Co., Massachusetts, in lat. 42° 30′ N., long. 72° 35′ W., is in very fertile country on the Connecticut River. Settled in 1866, it was incorporated a fire district in 1870. Water-works were built in 1873, by a private company, after plans of William P. Crocker, taking the supply from springs. This supply was found inadequate and a pump has been put in at the river, and a reservoir, which is 25 ft. above the village, is filled every night.

Distribution is by cast-iron pipe of 6 to 2 in. in diameter, with 10 fire hydrants.

The population in 1880 was 4,876.

No further information is given.

Wm. P. Crocker has charge of the works.

DCXLIX., PARKER CITY, PA.

Parker City, Armstrong Co., Pennsylvania, in lat. 41° N., long. 79° 45′ W., is on the Allegheny River.

Settled in 1869, it was incorporated a city in 1873. Water-works were built in 1872, by a private company, after plans of E. Versey, the supply being taken from the river and pumped thence by a steam pump, made by A. S. Cameron, to tanks of wood having an elevation above the pump of 420 ft., and giving a pressure on the distribution pipes of 150 lbs.

Distribution is by 8 miles of wood and iron pipes of 4 and 3 in. in diameter, with 28 fire hydrants, 35 gates and 240 taps. Service pipes are of galvanized iron. The city pays $300 yearly for hydrants.

The population in 1880 was 1,835, it is now said to be 5,400. The daily consumption in 1883 was 120,000 gals. The works have cost $20,000. The expense of maintenance in 1883 was $1,800, and the receipts were $4,000. O. Tursman is Superintendent of the works.

THE following replies to inquiries regarding reported water-works have been received:

Ann Arbor, Mich.—W. D. Harriman, Mayor, says: City has 10,000 inhabitants, no debt, etc., etc., and still has no water-works.

Billings, Montana.—F. Whitney says: There is no public water supply, but an experiment being made with an Artesian well.

Cottage City, Mass.—Editor *Star* says: No water supply.

Denison, Texas.—W. B. Boss, Mayor, says: No water-works; charter has, however, been granted to a company which has not yet accepted.

Findlay, Ohio.—W. W. Siddell, Mayor, says: No water-works yet; expect to build works this year (1884).

Forestport, N. Y.—Postmaster says: No public water supply.

Fort Smith, Ark.—Ed. McKenna says: No water-works yet; will have in summer of 1884.

Franklin, Mass.—Jos. G. Ray says: No water-works yet; will probably build before fall of 1884.

Hudson, Mass.—Charles H. Robinson, a water commissioner, says: No works yet, but have voted for works and will probably construct in coming season.

Lincoln, Neb.—R. E. Moore, Mayor, says: No system of water-works in use.

Monmouth, Ill.—Jno. S. Clark & Son say: No water-works; proposition by company made; action suspended.

Prescott, Arizona.—J. H. Carpenter, City Auditor, says: There are no water-works at present.

Sheboygan, Wis.—L. D. Harvey, Secretary of Water Co. says: Have no water-works, but are agitating the question.

Shelburne Falls, Mass.—G. R. Pierce says: Have no water-works.

St. Augustine, Fla.—J. P. Whitney says: No public water supply.

Orange, Mass.—A. French says: No water-works of any account; expect to erect good works another season.

Waterville, Me.—S. I. Abbott says: We have no water-works.

Woodbury, N. J.—Geo. H. Barker says: No water-works.

WATER.

KEOKUK, IA., has twelve miles of water main.

THE Nashville, Tenn., board of public works and affairs have awarded to Prof. O. H. Landreth, of Vanderbilt University, the contract for preparing plans and specifications for locating the Holly-Gaskill engine and new water-works system. Prof. Landreth is an efficient hydraulic engineer, and no doubt will give general satisfaction.

THE Lidgerwood Manufacturing Co., of New York, have recently shipped to the Atlanta Hill Gold Mining & Milling Co., of Atlanta, Idaho, one of their improved Patent Friction Drum Brake and Reversible Link Motion Combined Hoisting Engines complete. This engine has double cylinders, 10 inches bore and 12 inches stroke, with hoisting drum 54 inches diameter, and is of sufficient capacity to run a double compartment shaft 600 feet deep. These combination engines are claimed by the makers to be superior to any engine yet designed for mining purposes.

BELTON, TEX., May. 27.—Builders complain of the scarcity of mechanics. A number of stone masons could find steady employment at good wages—say $3.50 per day.

MAINTENANCE OF WATER-WORKS.—Below will be found a table of cities, showing what it costs to maintain water-works; the last right-hand column how much it costs to maintain each hydrant:

NAMES OF CITIES.	Population.	Cost of Works.	Daily consumption.	Annual cost of maintenance.	Annual cost and interest.	Total annual cost of maintenance.	Annual revenue.	Surplus cost and interest	Number of hydrants.	Cost of hydrants.
Newport, Ky.	20,443	$780,781 00	.....	$13,238 00	$46,846 00	$60,084 00	$21,861 00	$38,223 00	110	$347 00
Poughkeepsie, N.Y.	20,207	602,345 00	1,403,292	18,626 00	36,104 00	54,760 00	19,379 00	35,381 00	286	123 70
Zanesville, Ohio	18,120	500,000 00	1,947,000	17,200 00	30,000 00	47,200 00	28,897 00	18,303 00	154	119 00
Allentown, Pa.	18,063	189,054 00	1,000,000	3,403 00	11,343 00	14,746 00	16,438 00	.....	95	.....
Newtown, Mass.	16,995	854,937 00	468,476	9,759 00	51,296 00	61,054 00	33,754 00	27,300 00	324	84 00
Yonkers, N. Y.	18,892	669,299 00	900,000	9,462 00	40,157 00	49,619 00	15,995 00	33,624 00	246	136 00

Table showing prices paid per annum for hydrants in cities and villages as follows:

Ithica	N. Y.	$ 75.
Geneva	"	60
Oswego	"	50
Elmira	"	75
Auburn	"	68.50
Schenectady	"	71.88
Jamestown	"	60
Niagara Falls	"	50
Attica	"	50
Warsaw	"	62.50
West Troy	"	82
East New York	"	100
Kansas City	Mo.	110
Saint Paul	Minn.	60
Denver	Colo.	114
Manchester	N. H.	60
St. Joseph	Mo.	100
Dubuque	Ia.	75
Davenport	Ia.	70
New Brunswick	N. J.	50
Leavenworth	Kan.	75
New Albany	Ind.	100
Little Rock	Ark.	85
keakuk	Ia.	100
Cedar Rapids	Ia.	75
East Orange	N. J.	60
Alton	Ill.	100
Tiffon	Ohio.	90
Urbana	Ohio.	75
Lyons	Ia.	100
Meadville	Pa.	60
Traverse City	Mich.	100
West Springfield	Mass.	72

USEFUL INFORMATION.—A gallon of water (U. S. Standard) weighs 8⅓ lbs., and contains 231 cu. in.

A cubic foot of water weighs 62½ lbs., and contains 1,728 cu. in., or 7½ gals.

Each nominal horse-power of boilers requires 1 cu. ft. of water per hour.

In calculating horse-power of steam boilers, consider for tubular or flue boilers, 15 sq. ft. of heating surface, equivalent to one horse-power.

Condensing engines require 20 to 25 gals. of water to condense the steam evaporated from one gallon of water.

To find the pressure in pounds per square inch of a column of water, multiply the height of the column in feet by .434. (Approximately, every foot elevation is called equal to one-half pound pressure per square inch.)

To find the capacity of a cylinder in gallons. Multiplying the area in inches by the length of stroke in inches will give the total number of cubic inches; divide this amount by 231 (which is the cubical contents of a gallon in inches), and the product is the capacity in gallons.

Ordinary speed to run pumps is 100 ft. of piston per minute.

To find quantity of water elevated in one minute running at 100 ft. of piston per minute. Square the diameter of water cylinder in inches and multiply by 4. Example: capacity of a five-inch cylinder is desired; the square of the diameter (5 in.) is 25, which, multiplied by 4, gives 100, which is gallons per minute, (approximately.

To find the diameter of a pump cylinder to move a given quantity of water per minute (100 ft. of piston being the speed), divide the number of gallons by 4, then extract the square root, and the result will be the diameter in inches.

To find the velocity in feet per minute necessary to discharge a given volume of water in a given time, multiply the number of cubic feet of water by 144, and divide the product by the area of the pipe in inches.

To find the area of a required pipe, the volume and velocity of water being given, multiply the number of cubic feet of water by 144, and divide the product by the velocity in feet per minute. The area being found, it is easy to get the diameter of pipe necessary.

The area of the steam piston, multiplied by the steam pressure, gives the total amount of pressure exerted. The area of the water piston, multiplied by the pressure of water per square inch, gives the resistance. A margin must be made between the power and resistance, to move the pistons at the required speed; usually reckoned at about 80 per cent.—*The Deane Steam Pump Company's Catalogue.*

ACCORDING to the *Philadelphia Press*, Chief Ludlow, of the Water Department, is meeting with some opposition in his expressed intention of increasing the number of water meters in that city. In a recent interview he stated that there were about 8,500 manufacturing establishments in Philadelphia, and only 400, so far, are metered. He found the water rate, for meters, $1.75 per 1,000 cu. ft., or 16⅔ cts. per 1,000 gals.; this meter rate is now reduced to 60 cts. per 1,000 cu. ft., or about 8 cts. per 1,000 gals. When the horse-power used is easily ascertained, meters are not put in, the rate is simply calculated at $3 per horse-power.

The firm of Dolan & Sons, large woolen goods manufacturers, object to meters because they will sometimes stop, and through the lack of water delay their work They insist upon free use of water and say they will fight for it.

WITH this issue appears the new advertisement of the Wyckoff Pipe Company of Williamsport Penn., manufacturers of Wooden Water Pipe. We find on examination that it will not corrode nor rust out. Does not freeze easily, and very durable. Many Waterworks use this pipe. The above company will be pleased to send descriptive circulars and quote prices on application.—*Communicated.*

THE School of Engineering of Vanderbilt University Nashville, Tenn., received the first award for mechanical and architectural drawings at the Louisville Exposition. The exhibit consisted of fifty well mounted specimens of students' work, and attracted general attention.

CISTERNS IN THE AIR.—While a surveyor was resting at noon in a forest in Florida, one of the chainmen of his party exclaimed:

"I would give fifty cents a swallow for as much water as I could drink."

He expressed the sentiment of the others; for all were very thirsty, and there was not a spring or a stream of water anywhere in the vicinity. While the men were thus talking, the surveyor saw a crow put his bill into a cluster of broad, long leaves, growing on the side of a tall cypress. The leaves were those of an air-plant. They were green, and bulged out at the bottom, forming an inverted bell. The smaller end was held to the tree by roots grappling the bark. Feeding on the air and water that it catches and holds, the air-plant becomes a sort of cistern. The surveyor sprang to his feet with a laugh.

"Boys," he said, "that old crow is wiser than any of us."

"How so?" they asked.

"Why, he knows that there are a hundred thousand water-tanks in this forest."

"Where?" they demanded, in amazement.

The surveyor cut an air-plant in two, and drained nearly a pint of pure cold water from it. The men did not suffer for water after that; for every tree in the forest had at least one air-plant, and almost every air-plant contained a drink of water.

THE new mayor of Lansing, Mich., has been taking some exceptions to a plan of water-supply proposed by W. R. Coats, C. E., on the ground of danger of contamination of the proposed well by surface-water, and the excessive number of fire-hydrants and the price to be paid for their use. Mr. Coats replies in a letter in which he states that the proposed source of supply is in a gravel stratum overlaid by two feet of clay hardpan, which will prevent the percolation of surface-water. Regarding the number of hydrants, he says that to furnish and set a fire-hydrant which lasts an indefinite time, costs no more than to buy 50 feet of hose which wears out before very long. This seems to be a pretty good point in favor of putting in frequent hydrants on water-mains. As to proposed rates of compensation, he states that Flint, Mich., pays $75 per year for each hydrant, with 10 to each mile of mains; Adrian Mich., pays $83 per hydrants, there being 9. 6 hydrants to each mile; Elkhart Ind., pays $75 per hydrant, with 11.4 hydrants to each mile; while he proposed that Lansing should pay $92 per each hydrant, with 11.5 hydrants per mile of mains.—*Sanitary Engineer.*

JUNE 1, the Watertown Mass. Water Supply Company organized with the following officers; President, A. C. Davidson; Treasurer, J. H. Conant; Clerk, S. S. Gleason; Directors, A. O. Davidson, J. H. Conant, H. C. Derby, Francis Kendall, J. W. Coffin. A vote was passed authorizing the concern to start with a capital stock of $100,000. A code of by-laws was adopted. A meeting of the Directors will be held this evening, and subscription books for stock will soon be started.

THE New York *Tribune* gives the following remarks by R. W. Donnell, of Donnell, Lawson & Simpson, on the effect of their failure on the Kansas City Water-Works: Our failure will not affect the National Water-Works Company of Kansas City. Of course, it severs our connection with it, but the trust company holding its bonds will attend to the payment of the interest. The water-works were established in 1875, and sustained a loss that year of nearly $2,000. The average yearly increase since then has been 20 per cent., and last year the total net earnings were $131,000. This year they will not be less than $150,000, and as the stated charges against the company are less than $100,000, it will show a surplus of $50,000. The estimate for the next ten years, based upon a 15 per cent. yearly increase, shows total net earnings of $435,000."

ATLANTIC, IA., has six miles of water main and seventy-five hydrants.

MR. ED. LINN of Victoria, Texas, has succeeded in placing some water-works bonds of that place recently in New York.

THE contract for the Menominee, Mich., Waterworks has been let to C. E. GRAY of St. Louis, Mo., who is at present also building the Duluth, Minn., Waterworks. K. P. CORBYN, C. E., of 71 Major Block, Chicago, Ills. is to be Engineer in charge of construction at Menominee. It is expected that the Holly Manufacturing Co., will supply the machinery. Work will commence within 30 days.

IN response to a request from City Works Commissioner Fleeman, the Brooklyn Board of Aldermen on the 2nd, authorized the issue of water bonds in the sum of $440,000, for the purpose of adding, by means of sinking wells, 10,000,000 gallons a day to the city's water supply. The scheme, which has the approval of Mayor Low, was rendered necessary by the failure of the bill introduced in the last Legislature to extend the water-works beyond Rockville Centre.

"THAT'S a cool fellow," said an up-town manufacturer pointing across Chestnut street, where Colonel Ludlow, the Chief of the Water Department of Philadelphia, was waiting for a car. "Let me tell you something which happened a few days ago to a friend of mine, whose large establishment consumes a great deal of water, and who has frequent favors to ask of the Water Department. He recently visited the Chief's office, and found Colonel Ludlow, as usual, very polite. My friend, before preferring all of his requests, took a $50 bank bill from his pocket and passed it over to the Chief, who examined it curiously for a second and then spread it upon the desk before him. He did not utter a word at the moment, but when his visitor was about to go away said:

"'Now, my dear sir, what is this for?' holding up the bill.

"'Oh! that's to buy cigars for the boys,' was the careless reply.

"'Yes,' said Ludlow,' then I suppose that you are fond of the weed yourself?'

"My friend said that he enjoyed nothing better than a good cigar.

"'Then allow me,' said the Colonel, suavely, to insist upon your trying one of these,' moving to a secretary and taking down a box of Henry Clay Specials.

"Each gentleman took a cigar and bit off the end. Then with a careless gesture Colonel Ludlow rolled up the $50 bill into a paper-lighter, reached up to the gas, allowed it to become thoroughly ignited, and slowly lit his own cigar. You know that to light your own weed first is a good test of politeness. It comes from the French, who very sagely reason that whatever fumes or gases are generated in lighting will be absorbed into the first cigar. This done, the Colonel turned with an easy and polite motion, and said: 'Permit me,' and held the blazing bill under the nose and up to the cigar of my amazed and startled friend, whose eyes had now become almost as big as dinner plates. With two or three gasping inhalations he managed to get a light. He kept his eyes upon the bill until it burned to the very fingers which held it. Colonel Ludlow watched its last expiring spark as he idly allowed the smoke of his cigar to escape from between his lips. When the bank note had been completely reduced to ashes the Colonel turned to his visitor and said carelessly: 'How do you like your cigar?' The gentleman admitted its excellence and took his departure, attended to the door by the Chief, who with the utmost courtesy shook him by the hand, and then closed the door to resume his work at his desk. My friend gets purple in the face every time he thinks of the affair, and confided it to me simply to warn me how to behave myself at the Water Department."—*Phila. Record.*

THE GAS WOULD NOT BE BLOWN OUT.—Late last night a rather strange looking apparition appeared at the desk of the Howard House Baltimore, and asked the clerk what sort of lights he kept in his house. The clerk looked up in a bewildered sort of way, and saw before him a guest from the South who had registered during the evening.

"What's the matter?" inquired the clerk of the gentleman in deshabille.

"Well, you see," was the reply, "I have been trying for the last hour or so to blow out that infernal light in my room, and it won't go out."

The clerk sent a colored waiter with the guest from the South to show him how to turn off the gas.

NEWS OF THE WEEK.

Railroads and Canals.

RUSSIA has just contracted a loan of $75,000,000 to develop her railway system. The Argentine Republic is spending $28,000,000 for the same purpose; and Australia and India are also stretching out in this direction.

THE *Railroad Gazette* contains information of the laying of 77½ miles of new track, making 885 miles laid thus far this year, against 1,460 for the corresponding period last year, 2,991 in 1882, 1,386 in 1881 and 1,502 in 1880.

ON last Thursday, a week ago, a considerable section of the Shenandoah Branch of the Reading R. R., sank, near Shenandoah. A large force of men had been put to work to fill the breach when suddenly a portion of the road-bed sank beneath them to a depth "of fully 200 ft." Thomas Christ, of Mahanoy Plane, went down with the mass. Old mine-workings beneath caused the trouble.

FARGO, Dakota, May 29.—The fight between the Fargo, Larimore and Northern and the St. Paul, Minneapolis and Manitoba Railway Company, for the possession of a piece of grading forty miles long, from Mayville to Larimore, is in the district court here. An injunction is asked retraining the St. Paul, Minneapolis and Manitoba from building on the grade.

A RECENT dispatch from London says that the scheme for a canal from the Atlantic Ocean to the Mediterranean Sea, converting the Iberian Peninsula into an island, has been revived. A contract has been signed between the founders of the scheme and the contractors of the Suez Canal for a canal capable of taking the largest vessels through. The founders have asked the French Government for a guarantee of £400,000 yearly, to begin from 1889, when the works are expected to be completed.

COLONEL VAN FRANK, in charge of an engineering corps, fully equipped for a long survey, arrived at Wynne station quite recently, and will begin at once surveying the route for the Iron Mountain extension between Memphis and Beebe, Ark., where a junction will be made with the main line of the road. The survey will be made east from Wynne station, on the Helena branch of the St. Louis, Iron Mountain and Southern, to Memphis, thence west from same point to Beebe, in White County.

IT is proposed to build a narrow guage railroad from Prescott, Arizona, north through Chico Valley to the most eligible point on the Atlantic and Pacific railroad, a distance of about 60 miles. It is also proposed to extend the line to Phœnix, 110 miles southeast of Prescott, thence to connect the Southern Pacific Railroad at Maricopa, thus opening a market for the products of Salt River Valley in the numerous mining camps of northrn Arizona.

There seems to be no immediate prospect of rail connection between Oregon and California. The Oregon and California Company, which has only 28 miles to build to reach the California line, is reported to have stopped operations on account of lack of funds, and the Central Pacific, which has 100 miles of difficult work to complete to reach the point of junction, has stopped because of the communistic attitude of the California Legislature.

ON May 28, the western end of Krupp's Tunnel, on the South Penna. Railroad, caved in and instantly killed 9 laborers, and seriously injured 11 others, 2 of whom have since died.

The approach to the tunnel was out, and the heading for the tunnel proper had been driven 7 ft. when the accident occurred. The material was a treacherous sandstone and the depth of the cut at the tunnel entrance was 45 ft. A slip occurred, and in spite of all efforts of the men to further prop against the descending mass, the timbering was crushed with the above result.

The coroners jury exonerate the contractors, and ascribe the cause of the disaster to the presence of a vein of quicksand. Nearly all the men killed and injured were Italians and Spaniards.

INDIANAPOLIS, IND., May 29.—The Greencastle and Southern Railroad Company, with a capital stock of $5,000,000, was incorporated today. Its charter gives it the right to construct railroad lines in Putnam, Clay, Owen, Green, Sullivan, Knox, Daviess, Martin, Dubois, Warrick, Spencer and Perry Counties, including a line from Greencastle to Vincennes, and also to the Ohio River, a total estimated length of two hundred miles. Wm. H. Durham, Volney Q. Irwin, Wm. Ermentrout, Gilbert H. Brown, Wm. Daggy, Henry Jordan and John H. Piercy are Directors for the first year, with Durham as President; Ermentrout, Vice-president, and Brown, Secretary and Treasurer.

ROCHESTER, N. Y., May 29.—A line to be known as the Rochester and Lake Ontario Terminal Road has been surveyed, a company formed, and right of way purchased by which the Erie is to have an outlet to Lake Ontario. The length of the road will be nearly 11 miles. The company formed to incorporate the road is composed of 25 gentlemen who are well known as capitalists and business men. Among those prominently interested are E. R. Thompson, S. G. Doran, A. Pomeroy, A. T. Soule, J. M. Davy, Wilson Soule, and E. W. Maurer, of this city; James Rafferty, John Craigie, and Charles Yeomans, of Buffalo; William Bristoe, of Warsaw, and C. S. Upton, of Spencer. The cost of the road is to be $1,000,000, divided in shares of $100 each.

THE Union Pacific Railway Co. have completed the surveys of line to Yellowstone National Park. The route is from China Point, Idaho, on the U. & N. Division Eastward, *via* Dry and Comas Creeks to and up Snake River at Henry's Lake; thence two lines across the Rocky Mountains *via* Tahgee and Rea's Passes, at elevations 7,125 and 6,090 ft. respectively; thence to the Madison River and up that stream and Fire Hole River to Lower Geyser Basin; thence down the Madison River to the head of the Wisconsin below Gallatin City. Maximum grade 1% except crossing the range, when 2% was used. Distance 275 miles. The company have issued orders to locate and build extension of Wood River Branch, Oregon short line from Hailey to Ketchum, Idaho, 13 miles, and the location is now in progress.

THE LAND GRANTS.—The following official statement regarding the land grant roads will be found worth while taking out for reference:

Northern Pacific—Time fixed for completion, July 4, 1879; length of proposed road, 2,362,38 miles; completed within specified time, 530,5 miles; since completed, 1,340,88 miles; now uncompleted, 491 miles; estimated number of acres granted, 46,947,200; number of acres patented up to June 30, 1883, 746,390,22.

Atlantic and Pacific—Time fixed for completion, July 4, 1878; length of proposed line, 2,429 miles; completed within specified time, 1200 miles; completed since 600 miles; uncompleted, 1704 miles; acres granted, 40,690,560; acres patented to June 30, 1883, 950,206,87.

Southern Pacific—Length of proposed road, 556 miles; time fixed for completion, July 4, 1878; completed within specified time, 232 miles; completed since, 240 miles; uncompleted 84 miles; acres granted, 7,116,800; acres patented to June 30, 1883, 1,040,430,03.

Texas Pacific—Length of proposed road, 1483 miles; time fixed for completion of road, May 2, 1882, completed within specified time, 505 miles; now uncompleted, 778 miles; acres granted, 15,692,000; none patented to June 30, 1883.

RAILROAD STATISTICS.—The report of the railroad commissioners on the business of 1883, will give the following statistics on lines within the State of Missouri:

Number miles railroad	4,615
Number built in 1883	114
Gross stock on lines in Missouri	$117,776,238
Average per mile of road	24,429
Gross amount mortgage bonds	106,758,557
Average per mile of road	24,106
Gross amount stock and bonds	244,724,795
Average per mile	50,535
Gross transportation earnings	28,754,335
Average per mile operated	6,343
Gross operating and general expenses	18,126,911
Average per mile	3,996
Ratio of expense and earning, 65 per cent.	
Total net earnings	10,627,424
Average per mile	2,347
Total interest charges above	6,500,000
Total surplus after paying expense and interest	4,127,424

MR. JAY GOULD'S SUPPOSED LOSSES.—NEW YORK, May 29.—Mr. Gould's losses through the shrinkage of his property have been enormous. He has a large amount of stock held for investment, and all of it is very much below the quotations of two or three years ago. Put down in tabular form the figures would look something like this:

Stock	Shares.	Highest 1881.	Lowest 1884.	Loss.
W. U.	300,000	93	49	$13,200,000
Mo. Pacific	120,000	114	65	5,880,000
D., L. & W.	10,000	150	104	460,000
Wab. pref.	10,000	92	11	810,000
Wab. com.	20,000	60	7	1,060,000
Am. Cable	8,000	78	49	232,000
Total loss				$21,642,000

Enormous as these figures are, they do not represent entirely the shrinkage of Mr. Gould's fortune, for he is possessor of many railway mortgages and of stock in many banking and trust companies, car companies and bridge and warehouse companies, nearly every one of which is worth less money than it was three years ago. It is safe to say that the market value of Mr. Gould's securities has shrunk $25,000,000.

LITTLE ROCK, ARK., May 30.—Articles of association were filed this morning with the secretary of State for the Kansas City, Arkansas and Fort Smith Railway company. The road will be built from Kansas City to Fort Smith. It will strike Arkansas in Boone county, thence through Washington, Crawford and Sebastian counties to Fort Smith. The capital stock is $1,500,000. One thousand dollars per mile of the proposed road have been subscriber and paid. A. Bearden, B. S. Morris, J. R. Rutherford, J. B. Newberry and R. J. Egy are the board of directors.

A NEW ILLINOIS RAILROAD.—SHABBONA, Ill., May 30.—There having been so many conjectures about the new railroad, the *Chicago Times* correspondent sought an interview with Hon. D. B. Waterman, of Aurora, who is buying the right of way, and knows whereof he speaks. The line is called the "Northern Illinois" railroad, running from Belvidere to Peru. It has not been decided whether to go by Malta or De Kalb, the latter route being five miles the longest, or eighty-five miles. It is probable that the road will go by De Kalb. The right of way has been determined and mostly obtained from Peru into Shabbona Grove. Grading will commence as soon as the line is fully located. It is expected to have the road running before next winter. Sixteen thousand acres of land have been purchased six miles west of Peru, on the Illinois river. Twenty miles of sidings will be built on the coal-fields and to Peru. The company will mine four thousand tons of soft coal a day. It is surmised that the Northwestern system will in due time swallow the present corporation.

Contracting Miscellany.

ST. PAUL, Minn., May 26.—The court-house commission met to-day and arranged to push work on the new structure. The plans of C. P. Bassford, architect of this city, were accepted. The building will cost $300,000.

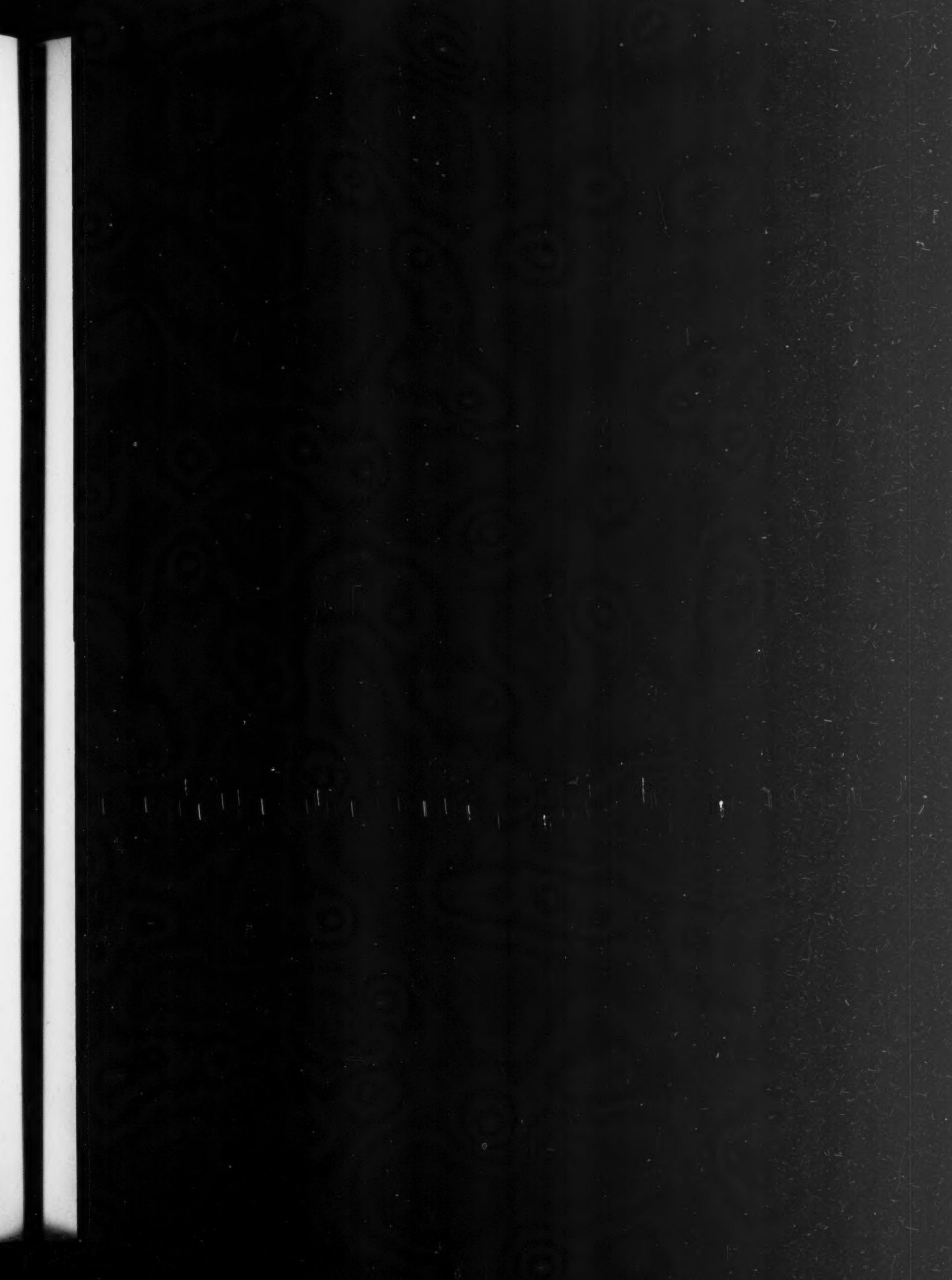
VICKSBURG, Miss., May 27.—An examination of the new cut-off made from Waterproof to Largent discloses the following facts: The maximum depth of water in the cut-off is 102 ft.; the width from 1,000 to 1,300 ft.; the length over 3,000 ft. It will shorten the river 12 miles.

THE Directors of the Northern Pacific Railroad last week authorized the letting of the work of construction for the section of 25 miles—east from Tacoma in the direction of the Green River and Stampede Pass, Washington Territory.

THE German iron and steel industry society is publishing an illustrated work on the uses of iron and steel in the building-trade, giving full directions for any workman to apply for himself. The expenses will amount to £1,750, and the members of the society call upon all interested in the iron-trade to contribute towards them.

ON May 19, the Fuel Gas Co., of Allegheny County, Pa., let a contract to the Penn. Tube works, of Pittsburgh, for two lines of 8 in. pipe, from their wells at Murrayville to Pittsburgh. Forty miles of pipe will be required, and 3,000 tons of iron to make it. The contract for digging the ditch and laying the pipe was awarded to C. W. Lewis. The entire cost of the pipe and pipe-laying will be $300,000.

THE brig Senorita sailed a few days ago from the wharf of the Repauno Chemical Co's. works, Thompson's Point, N. J., for Aspinwall, with a cargo of 50 tons of Atlas powder, 2,000 cases in all. This powder is intended for use on the Panama Canal; the powder contains 75 per cent. of nitro-glycerine, and the cartridges have the fuses attached to them, owing to the inability of the employés of the company to attach them properly.

MILLERSBURG, O., May 28.—The plans and specifications of the new $75,000 court house have been accepted by the commisioners from Mr. Yost, the architect. Sealed proposals are advertised for this week, to be received until noon of July 1st, after which time the bids will be opened and the contracts let. The building will be of blue sandstone for the body and white sandstone for the trimmings, and when finished will be a very imposing edifice.

ENGINEERING NEWS: Three months for One Dollar.